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Pesticides

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MCPA

(4-chloro-2-methylphenoxyacetic acid)

Pesticide Registration Standard

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MCPA and its Salts and Esters
Pesticide Registration Standard

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Chapter I

HOW TO REGISTER UNDER A REGISTRATION STANDARD

Organization of the Standard
Purpose of the Standard
Requirement to Re-register Under the Standard
"Product Specific" Data and "Generic" Data
Data Compensation Requirements under FIFRA 3(c)(1)(D)
Obtaining Data to Fill "Data Gaps;" FIFRA 3(c)(2)(B)
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Organization of the Standard

This first chapter explains the purpose of a Registration Standard and summarizes the legal principles involved in registering or re-registering under a Standard. The second chapter sets forth the requirements that must be met to obtain or retain registration for products covered by this particular Registration Standard. In the remaining chapters, the Agency reviews the available data by scientific discipline, discusses the Agency's concerns with the identified potential hazards, and logically develops the conditions and requirements that would reduce those hazards to acceptable levels.

Purpose of the Standard

Section 3 of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) provides that "no person in any State may distribute, sell, offer for sale, hold for sale, ship, deliver for shipment, or receive (and having so received) deliver or offer to deliver, to any person any pesticide which is not registered with the Administrator [of EPA]." To approve the registration of a pesticide, the Administrator must find, pursuant to Section 3(c)(5) that:

> "(A) its composition is such as to warrant the proposed claims for it;
> (B) its labeling and other material required to be submitted comply with the requirements of this Act;
> (C) it will perform its intended function without unreasonable adverse effects on the environment; and
> (D) when used in accordance with widespread and commonly recognized practice it will not generally cause unreasonable adverse effects on the environment."

In making these findings, the Agency reviews a wide range of data which registrants are required to submit, and assesses the risks and benefits associated with the use of the proposed pesticide. But the established approach to making these findings has been found to be defective on two counts:

First, EPA and its predecessor agency, the United States Department of Agriculture (USDA), routinely reviewed registration applications on a 'product-by-product' basis, evaluating each product-specific application somewhat independently. In the review of products containing similar components, there

was little opportunity for a retrospective review of the full range of pertinent data available in Agency files and in the public literature. Thus the 'product-by-product' approach was often inefficient and sometimes resulted in inconsistent or incomplete regulatory judgements.
Second, over the years, as a result of inevitable and continuing advances in scientific knowledge, methodology, and policy, the data base for many pesticides came to be considered inadequate by current scientific and regulatory standards. Given the long history of pesticide regulation in several agencies, it is even likely that materials may have been lost from the data files. When EPA issued new requirements for registration in 1975 (40 CFR 162) and proposed new guidelines for hazard testing in 1978 (43 FR 29686, July 10, 1978 and 43 FR 37336, August 2, 1978), many products that had already been registered for years were being sold and used without the same assurances of human and environmental safety as was being required for new products. Because of this inconsistency, Congress directed EPA to re-register all previously registered products, so as to bring their registrations and their data bases into compliance with current requirements [See FIFRA Section 3(g)].

Facing the enormous job of re-reviewing and calling-in new data for the approximately 35,000 current registrations, and realizing the inefficiencies of the 'product-by-product' approach, the Agency decided that a new, more effective method of review was needed.

A new review procedure has been developed. Under it, EPA publishes documents called Registration Standards, each of which discusses a particular pesticide active ingredient. Each Registration Standard summarizes all the data available to the Agency on a particular active ingredient and its current uses, and sets forth the Agency's comprehensive position on the conditions and requirements for registration of all existing and future products which contain that active ingredient. These conditions and requirements, all of which must be met to obtain or retain full registration or re-registration under Section 3(c)(5) of FIFRA, include the submission of needed scientific data which the Agency does not now have, compliance with standards of toxicity, composition, labeling, and packaging, and satisfaction of the data compensation provisions of FIFRA Section 3(c)(1)(D).

The Standard will also serve as a tool for product classification. As part of the registration of a pesticide product, EPA may classify each product for "general use" or "restricted use" [FIFRA Section 3(d)]. A pesticide is classified for "restricted use" when some special regulatory restriction is needed to ensure against unreasonable adverse effects to man or the environment. Many such risks of unreasonable adverse effects can be lessened if expressly-designed label precautions are strictly followed. Thus the special regulatory restriction for a "restricted use" pesticide is usually a requirement that it be applied only by, or under the supervision of, an applicator who has been certified by the State or Federal government as being competent to use pesticides safely, responsibly, and in accordance with label directions. A restricted-use pesticide can have other regulatory restrictions [40 CFR 162.11(c)(5)] instead of, or in addition to, the certified applicator requirement. These other regulatory restrictions may include such actions as seasonal or regional limitations on use, or a requirement for the monitoring of residue levels after use. A pesticide classified for "general use," or not classified at all, is available for use by any individual who is in compliance with State or local regulations. The Registration Standard review compares information about potential adverse effects of specific uses of the pesticides with risk criteria listed in 40 CFR 162.11(c), and thereby determines whether a product needs to be classified for "restricted use." If the Standard does classify a pesticide for "restricted use," this determination is stated in the second chapter.

Requirement to Re-register Under the Standard

FIFRA Section 3(g), as amended in 1978, directs EPA to re-register all currently registered products as expeditiously as possible. Congress also agreed that re-registration should be accomplished by the use of Registration Standards.

Each registrant of a currently registered product to which this Standard applies, and who wishes to continue to sell or distribute his product in commerce, must apply for re-registration. His application must contain proposed labeling that complies with this Standard.

EPA will issue a notice of intent to cancel the registration of any currently registered product to which this Standard applies if the registrant fails to comply with the procedures for re-registration set forth in the Guidance Package which accompanies this Standard.

"Product Specific" Data and "Generic" Data

In the course of developing this Standard, EPA has determined the types of data needed for evaluation of the properties and effects of products to which the Standard applies, in the disciplinary areas of Product Chemistry, Environmental Fate, Toxicology, Residue Chemistry, and Ecological Effects. These determinations are based primarily on the data Guidelines proposed in 1978 (43 FR 29686, July 10, 1978, and 43 FR 37336, August 2, 1978), as applied to the use patterns of the products to which this Standard applies. Where it appeared that data from a normally applicable Guidelines requirement was actually unnecessary to evaluate these products, the Standard indicates that the requirement has been waived. On the other hand, in some cases studies not required by the Guidelines may be needed because of the particular composition or use pattern of products the Standard covers; if so, the Standard explains the Agency's reasoning. Data guidelines have not yet been proposed for the Residue Chemistry discipline but the requirements for such data have been in effect for some time and are, the Agency believes, relatively familiar to registrants. Data which we have found are needed to evaluate the registrability of some products covered by the Standard may not be needed for the evaluation of other products, depending upon the composition, formulation type, and intended uses of the product in question. The Standard states which data requirements apply to which product categories. (See the second chapter.) The various kinds of data normally required for registration of a pesticide product can be divided into two basic groups:

(A) data that is "product specific," i.e., data that relates only to the properties or effects of a product with a particular composition (or a group of products with closely similar composition); and

(B) "generic" data that pertains to the properties or effects of a particular ingredient, and thus is relevant to an evaluation of risks and benefits of all products containing that ingredient (or all such products having a certain use pattern), regardless of any such product's unique composition.

The Agency requires certain "product specific" data for each product to characterize the product's particular composition and physical/chemical properties (Product Chemistry), and to characterize the product's acute toxicity (which is a function of its total composition). The applicant for registration or re-registraton of any product, whether it is a manufacturing-use or end-use product, and without regard to its intended use pattern, must submit or cite enough of this kind of data to allow EPA to evaluate the product. For such purposes, "product specific" data on any product other than the applicant's is irrelevant, unless the other product is closely similar in composition to the applicant's. (Where it has been found practicable to group similar products for purposes of evaluating, with a single set of tests, all products in the group, the Standard so indicates.) "Product specific" data on the efficacy of particular end-use products is also required where the exact formulation may affect efficacy and where failure of efficacy could cause public health problems.

All other data needed to evaluate pesticide products concerns the properties or effects of a particular ingredient of products (normally a pesticidally active ingredient, but in some cases a pesticidally inactive, "inert," ingredient). Some data in this "generic" category are required to evaluate the properties and effects of all products containing that ingredient [e.g., the acute LD-50 of the active ingredient in its technical or purer grade; see proposed 40 CFR 163.81-1(a), 43 FR 37355].

Other "generic" data are required to evaluate all products which both contain a particular ingredient and are intended for certain uses (see, e.g., proposed 40 CFR 163.82-1, 43 FR 37363, which requires subchronic oral testing of the active ingredient with respect to certain use patterns only). Where a particular data requirement is use-pattern dependent, it will apply to each end-use product which is to be labeled for that use pattern (except where such end-use product which is to be labeled for that use pattern (except where such end-use product is formulated from a registered manufacturing-use product permitting such formulations) and to each manufacturing-use product with labeling that allows it to be used to make end-use products with that use pattern. Thus, for example, a subchronic oral dosing study is needed to evaluate the safety of any manufacturing-use product that legally could be used to make an end-use, food-crop pesticide. But if an end-use product's label specified it was for use only in ways that involved no food/feed exposure and no repeated human exposure, the subchronic oral dosing study would not be required to evaluate the product's safety; and if a manufacturing-use product's label states that the product is for use only in making end-use products not involving food/feed use or repeated human exposure, the subchronic oral study would not be relevant to the evaluation of the manufacturing-use product either.

If a registrant of a currently registered manufacturing-use or end-use product wishes to avoid the costs of data compensation [under FIFRA Section 3(c)(1)(D)] or data generation [under Section 3(c)(2)(B)] for "generic" data that is required only with respect to some use patterns, he may elect to delete those use patterns from his labeling at the time he re-registers his product. An applicant for registration of a new product under this Standard may similarly request approval of only certain use patterns.

Data Compensation Requirements under FIFRA 3(c)(1)(D)

Under FIFRA Section 3(c)(1)(D), an applicant for registration, re-registration, or amended registration must offer to pay compensation for certain existing data the Agency has used in developing the Registration Standard. The data for which compensation must be offered is all data which is described by all the following criteria:

(1) the data were first submitted to EPA (or to its predecessor agencies, USDA or FDA), on or after January 1, 1970;

(2) the data were submitted to EPA (or USDA or FDA) by some other applicant or registrant in support of an application for an experimental use permit, an amendment adding a new use to a registration, or for re-registration, or to support or maintain in effect an existing registration;

(3) the data are relevant to the Agency's decision to register or re-register the applicant's product under the Registration Standard, taking into account the applicant's product's composition and intended use pattern(s);

(4) the data are determined by EPA to be valid and usable in reaching regulatory conclusions; and

(5) the data are not those for which the applicant has been exempted by FIFRA Section 3(c)(2)(D) from the duty to offer to pay compensation. (This exemption applies to the "generic" data concerning the safety of an active ingredient of the applicant's product, not to "product specific" data. The exemption is available only to applicants whose product is labeled for end-uses for which the active ingredient in question is present in the applicant's product because of his use of another registered product containing that active ingredient which he purchases from another producer.)

An applicant for re-registration of an already registered product under this Standard, or for registration of a new product under this Standard, accordingly must determine which of the data used by EPA in developing the Standard must be the subject of an offer to pay compensation, and must submit with his application the appropriate statements evidencing his compliance with FIFRA Section 3(c)(1)(D).

An applicant would never be required to offer to pay for "product-specific" data submitted by another firm. In many, if not in most cases, data which are specific to another firm's product will not suffice to allow EPA to evaluate the applicant's product, that is, will not be useful to the Agency in determining whether the applicant's product is registrable. There may be cases, however, where because of close similarities between the composition of two or more products, another firm's data may suffice to allow EPA to evaluate some or all of the "product specific" aspects of the applicant's product. In such a case, the applicant may choose to cite that data instead of submitting data from tests on his own product, and if he chooses that option, he would have to comply with the offer-to-pay requirements of Section 3(c)(1)(D) for that data.

Each applicant for registration or re-registration of a manufacturing-use product, and each applicant for registration or re-registration of an end-use product, who is not exempted by FIFRA Section 3(c)(2)(D), must comply with the Section 3(c)(1)(D) requirements with respect to each item of "generic" data that relates to his product's intended uses.

A detailed description of the procedures an applicant must follow in applying for re-registration (or new registration) under this Standard is found in the Guidance Package for this Standard.

Obtaining Data to Fill "Data Gaps"; FIFRA 3(c)(2)(B)

Some of the kinds of data EPA needs for its evaluation of the properties and effects of products to which this Standard applies have never been submitted to the Agency (or, if submitted, have been found to have deficiencies rendering them inadequate for making registrability decisions) and have not been located in the published literature search that EPA conducted as part of preparing this Standard. Such instances of missing but required data are referred to in the Standard as "data gaps."

FIFRA Section 3(c)(2)(B), added to FIFRA by the Congress in 1978, authorizes EPA to require registrants to whom a data requirement applies to generate (or otherwise produce) data to fill such "gaps" and submit those data to EPA. EPA must allow a reasonably sufficient period for this to be accomplished.

If a registrant fails to take appropriate and timely steps to fill the data gaps identified by a Section 3(c)(2)(B) order, his product's registration may be suspended until the data are submitted. A mechanism is provided whereby two or more registrants may agree to share in the costs of producing data for which they are both responsible.

The Standard lists, in its summary second chapter, the "generic" data gaps and notes the classes of products to which these data gaps pertain. The Standard also points out that to be registrable under the Standard, a product must be supported by certain required "product specific" data. In some cases, the

Agency may possess sufficient "product specific" data on one currently registered product, but may lack such data on another. Only those Standards which apply to a very small number of currently registered products will attempt to state definitively the "product specific" data gaps on a 'product by product' basis. (Although the Standard will in some cases note which data that EPA does possess would suffice to satisfy certain "product specific" data requirements for a category of products with closely similar composition characteristics.)

As part of the process of re-registering currently registered products, EPA will issue Section 3(c)(2)(B) directives requiring the registrants to take appropriate steps to fill all identified data gaps -- whether that data in question is "product specific" or "generic" — in accordance with a schedule.

Persons who wish to obtain registrations for new products under this Standard will be required to submit (or cite) sufficient "product specific" data before their applications are approved. Upon registration, they will be required under Section 3(c)(2)(B) to take appropriate steps to submit data needed to fill "generic" data gaps. (We expect they will respond to this requirement by entering into cost-sharing agreements with other registrants who previously have been told they must furnish the data.) The Guidance Package for this Standard details the steps that must be taken by registrants to comply with Section 3(c)(2)(B).

Amendments to the Standard

Applications for registration which propose uses or formulations that are not presently covered by the Standard, or which present product compositions, product chemistry data, hazard data, toxicity levels, or labeling that do not meet the requirements of the Standard, will automatically be considered by the Agency to be requests for amendments to the Standard. In response to such applications, the Agency may request additional data to support the proposed amendment to the Standard, or may deny the application for registration on the grounds that the proposed product would cause unreasonable adverse effects to the environment. In the former case, when additional data have been satisfactorily supplied, and providing that the data do not indicate the potential for unreasonable adverse effects, the Agency will than amend the Standard to cover the new registration.

Each Registration Standard is based upon all data and information available to the Agency's reviewers on a particular date prior to the publication date. This "cut-off" date is stated at the beginning of the second chapter. Any subsequent data submissions and any approved amendments will be incorporated into the Registration Standard by means of addenda, which are available for inspection at EPA in Washington, D.C., or copies of which may be requested from the Agency. When all the present "data gaps" have been filled and the submitted data have been reviewed, the Agency will revise the Registration Standard. Thereafter, when the Agency determines that the internally maintained addenda have significantly altered the conditions for registration under the Standard, the document will be updated and re-issued for publication.

While the Registration Standard discusses only the uses and hazards of products containing the designated active ingredient(s), the Agency is also concerned with the potential hazards of some inert ingredients and impurities. Independent of the development of any one Standard, the Agency has initiated the evaluation of some inert ingredients of concern in a specific product to which the Standard applies, these ingredients will be pointed out in the Guidance Package.

CHAPTER II

AGENCY POSITION ON MCPA

Introduction

This chapter describes in detail the Agency's regulatory position on products that contain MCPA as the sole active ingredient. The regulatory position adopted by the Agency incorporates a number of considerations. Foremost among these considerations is an analysis of the registrability of products containing MCPA based on the risk criteria found in Section 162.11(a) of Title 40 of the U.S. Code of Federal Regulations. The Agency's determination and the rationale for its determination are presented below.

In addition to this decision, standards of product composition, acute toxicity, and use are established. The rationale for establishing a particular standard follows the presentation of the standard. Regulatory actions such as requiring protective clothing during application are prescribed, and any additional data to support the registrations are requested. The basis for any regulatory action can be found by first reading the rationale for the action, which follows the chosen option. Further information, on the scientific basis for an action, can be found by reading the various chapters that summarize available scientific data on the safety of MCPA.

Description of Chemical

MCPA is the common name for the chemical 4-chloro-2-methylphenoxyacetic acid. MCPA is a phenoxy herbicide registered for use in a variety of crop and noncrop sites to control a wide spectrum of broadleaf weeds. It is principally used in wheat, rice, and other small grains. The Chemical Abstracts Registry (CAS) number for MCPA is 94-74-6, and the EPA Shaughnessy Code is 030501.

Currently registered manufacturing-use products include MCPA acid, the dimethylamine salt of MCPA, the butoxyethyl ester, the butyl ester, the isooctyl ester, and a mixture product containing the isobutyl, isopropyl, and butyl esters.

MCPA formulated products are marketed under the trade names Mephanac^{R}, Methoxone^{R}, Agroxone^{R}, MCP^{R}, and Weedar^{R}, to name a few. These products are available as soluble concentrates and emulsifiable concentrates, and they contain many different forms of MCPA (the sodium salt, the diethanolamine salt, the dimethylamine salt, the isooctyl ester, the butoxyethyl ester, and a mixture of butyl and isopropyl esters).

Regulatory Position

MCPA (4-chloro-2-methylphenoxyacetic acid), MCPA sodium salt, the dimethylamine salt of MCPA, the diethanolamine salt of MCPA, the isooctyl ester of MCPA, the butoxyethyl ester of MCPA, the butyl ester of MCPA, the mixture of butyl and isopropyl esters of MCPA, and the mixture of isobutyl, isopropyl, and butyl esters of MCPA as described in this Standard, may be registered for sale, distribution, reformulation, and use in the United States. In preparing this Standard, the Agency has considered the scientific data obtained from the open literature through April 1981 and data submitted by the registrant up to the date of publication of the Standard. Based on a review of these data, the Agency finds that MCPA has neither met nor exceeded any of the risk criteria found in section 162.11(a) of Title 40 of the U.S. Code of Federal Regulations. Gaps in the data base preclude the completion of the Agency's risk assessment. The Agency has determined that MCPA does not cause unreasonable adverse effects to either man or the environment when used in accordance with prescribed label directions and precautions.

Currently registered products containing MCPA as the sole active ingredient may be reregistered under this Standard. New products may be registered under this Standard, provided the proposed products meet acceptable standards of product composition, use and toxicity as described below.

Regulatory Rationale

MCPA (4-chloro-2-methylphenoxyacetic acid) and its salts and esters are phenoxy herbicides with chemical structures very similar to 2,4-D. The majority of MCPA is applied postemergence by farmers or professional applicators. MCPA is currently registered for outdoor, nondomestic food crop and nonfood crop uses. From 85 to 95% of MCPA usage is on wheat, rice, barley, oats, and rye. Other uses include applications to rangelands and turf.

The Agency has completed a thorough review of available data on the safety of MCPA, and has identified several studies that indicate MCPA may be teratogenic, fetotoxic, and may affect spermatogenesis. In addition, data were available that indicated MCPA may be a weak mutagen. Some of the data indicating adverse effects do not meet Agency standards for testing. Flaws in protocol and study design reduce Agency confidence in reported results (see Chapter 6 for details). Also, additional data were available that indicated MCPA did not induce teratogenic, fetotoxic, reproductive, or mutagenic effects. In the face of conflicting and inconclusive data, the Agency does not consider it prudent regulatory policy to proceed with a presumption against the registration of MCPA at this time.

However, the Agency is concerned whenever positive effects are reported in submitted data. Because of its concern, the Agency has completed a preliminary dietary risk assessment using the No Observable Effect Level (NOEL) of 4 mg/kg (the lowest NOEL reported). A summary of available positive effects data follows, and the dietary risk assessment follows this summary. Chapter 6 includes full discussions of all reviewed data.

Available data on the teratogenic potential of MCPA include studies indicating that dietary administration of MCPA induced dose-related minor skeletal defects and decreased fetal weights. The NOEL based on the incidence of minor skeletal defects and decreased fetal weights was 25 mg/kg in rats (see Chapter

6 for details). In a separate study, MCPA was administered to rats in dietary doses of 2, 30, 60, and 100 mg/kg. At 60 and 100 mg/kg, the malformation rate was significantly increased, and fetal weights were significantly decreased. The NOEL for fetotoxicity was 30 mg/kg (see Chapter 6 for details).

Available data on potential effects of MCPA administration on spermatogenesis includes a study that indicates dietary administration of MCPA may induce dose-related curtailment of spermatogenic activity, tubular atrophy, and prostatic alterations. The NOEL based on the effects described above is 4 mg/kg in beagle dogs. In a separate study, deemed inadequate by Agency standards, MCPA was administered to young male Sprague-Dawley rats at doses of 100, 500, 1,000, 2,000 and 3,000 ppm. Rats receiving 100 ppm (3 mg/kg/day) had slight degeneration of the seminiferous tubules. Those receiving doses of 500 ppm (61 mg/kg/day) and 1,000 ppm (112 mg/kg/day) had mild degeneration of the seminiferous tubules with loss of spermatids. The use of less than 10 rats per dose, the short duration of the study, and discrepancies in the recording of some data were the major deficiencies noted in the Agency's review of this study.

Available data on potential mutagenic effects of MCPA include studies suggesting MCPA is a weak mutagen in _Saccharomyces cerevisiae_ and a weak mutagen in Drosophila. In addition, one study indicates that MCPA may cause inhibition of testicular DNA synthesis in male mice.

The Agency is requiring additional testing of MCPA for reproductive effects because available data are inconclusive (see Chapter 6). However, because adverse reproductive effects were reported in several studies, the Agency has completed a preliminary dietary risk assessment, using the conclusions of the subchronic feeding study which reported effects on spermatogenesis and a NOEL of 4 mg/kg.

Dietary Risk

In order to assess the risk for dietary exposure to MCPA, a worst case dietary risk assessment based on the conclusions of the subchronic feeding study in beagle dogs is used (Holsing, 1970, 000004757). The NOEL reported in this study is the lowest level reported that indicated adverse effects. This study reported adverse effects on spermatogenesis and a NOEL of 4 mg/kg. (see Table 2-1)

TABLE 2-1

Reported Incidence of Spermatogenic Effects

Dose (mg/kg)	0	4	8	16
Incidence	1/4	1/4	2/4	3/4

The TMRC (Theoretical Maximum Residue Contribution) of MCPA to the human diet is .77 mg/day (see Chapter 7). The theoretical dietary exposure of an average man equals the TMRC divided by the weight of the average man (60 kg): .013 mg/kg/day. The oral NOEL from the study discussed above is 4 mg/kg. The PADI (Provisional Acceptable Daily Intake), using a 2,000-fold safety factor, is .002 mg/kg/day. (The ADI is termed provisional because chronic feeding studies are not available to confirm the reported NOEL in subchronic testing. Likewise, a 2,000-fold safety factor is used because the NOEL is from a subchronic study.) The theoretical dietary exposure of an average man to residues of MCPA in food exceeds the (provisional) acceptable daily intake by a factor of approximately 6. Thus, there is a safety factor of approximately 333 rather than 2,000.

The ADI is provisional and was calculated using a 2,000-fold safety factor. Chronic testing of MCPA is required as one of the conditions for continued registration under this Standard. Calculations of an ADI using the customary 100-fold safety factor (when long-term testing is available) and the same NOEL as reported above, give an ADI of .04 mg/kg. The theoretical dietary exposure figure of .013 mg/kg/day would be acceptable because it is less than the ADI.

Because the ADI is only provisional, the Agency is not taking any action to revoke existing tolerances even though theoretical dietary exposure exceeds the maximum permissible intake. However, the Agency will not consider any additional tolerances for the use of MCPA in or on food or feed until acceptable chronic feeding data have been provided.

Applicator Exposure

The vast majority of MCPA is applied postemergence by farmers and professional applicators. Product concentrations of MCPA acid equivalent range from 1 to 4 pounds active equivalent per gallon of product, with 4 pounds being the most common. Most is broadcast by fixed-boom ground rig sprayers in about 10-30 gallons of water carrier per acre. An appreciable amount is also broadcast aerially, especially in rice. Aerial applications use 2 to 10 gallons of water per acre. Crop sites are normally sprayed only once per season at an average application rate of 0.5 pounds active ingredient per acre.

MCPA may induce adverse reproductive effects at concentrations as low as 4 mg/kg body weight. Therefore, the Agency is concerned about applicator exposure during the mixing and application of spray formulations. Because the Agency is awaiting the results of further reproductive testing, quantitative applicator exposure and risk assessments are not being completed at this time.

The Agency will complete a full applicator exposure and risk assessment if the results of required toxicological testing confirm the Agency's preliminary determination that MCPA may induce adverse effects on spermatogenesis.

Test Substances for Required Testing

As a typical weak acid ($pK_a = 3.1$), MCPA exists in solution in two forms, depending on the pH. Below pH 3.1, the un-ionized, protonated form (MCPA acid) predominates, and above this pH, MCPA anion (salt form) predominates. Because of the interconvertability of MCPA acid and salt forms, MCPA and its salts may be considered as one entity for most categories of testing.

For esters of MCPA, the situation is different. The Agency has no data on the rates of hydrolysis of MCPA esters in living or nonliving systems, and therefore has no basis for saying that MCPA acid and its esters are equivalent for testing purposes. Registrants of products containing esters of MCPA acid have the option of providing all categories of data on each ester form, or of citing data showing that a particular ester would be equivalent to MCPA acid under test conditions. The Agency will consider such a rationale based on registrant-supplied data on analogous chemicals (for instance, 2,4-D).

Potential for Nitrosamine Contamination

Amine and alkanolamine salts of phenoxyacetic acids may contain nitrosamines as a result of (1) nitrosamine contamination of the amine or alkanolamine used to produce the salts, or (2) addition of nitrite to the product to inhibit corrosion during storage. Samples of an amine salt formultion of MCPA obtained "off-the-shelf" contained up to .7 ppm N-nitrosodimethylamine.

Because 80% of all N-nitrosamines have been shown to be carcinogens, the Agency is requiring analyses of products that are most likely to be contaminated with N-nitrosamines. Each registrant of a manufacturing-use product containing an amine or alkanolamine salt of MCPA is required to analyze the product for nitrosamines immediately after manufacture, and either certify that nitrites are not added to the formulated products, or analyze the formulated products after storage.

Following the submission of data and the submission of required risk assessments where necessary in accordance with 45 FR 42854, the Agency will reevaluate the registrability of MCPA.

Potential for Dioxin Contamination

Some published procedures for the manufacture of MCPA use chlorocresols as starting or intermediate materials. Chlorinated phenols are dioxin precursors under certain conditions. The Agency is requiring the analysis of MCPA technical acid (manufactured with chlorocresols) for chlorinated dioxins. In addition, end-use products developed under an integrated formulation system (for which there is no registered MCPA technical product) must also be analyzed for chlorinated dioxins. Alternatively, registrants have the option of supplying detailed discussions of why dioxins are not likely to be found in the product.

Criteria for Registration Under the Standard

To be subject to this Standard, MCPA products must:

- contain MCPA as the sole active ingredient;
- be within any established standards of product composition;
- be within acceptable acute toxicity limits;
- be labeled for acceptable end-uses; and
- bear required labeling.

The applicant for registration or reregistration of products under this Standard must comply with all terms and conditions described in this Standard, including a commitment to fill any data gaps in accordance with the time schedule specified by the Agency, and, when applicable, offer to pay compensation to the extent required under Section 3(c)(1)(D) of FIFRA, as amended, 7 U.S.C. 136(c)(1)(D). As discussed in Chapter I, applicants for registration under this Standard must contact the Agency for specific instructions, including updated information on data and compensation requirements.

A. Manufacturing-use MCPA

1. Acceptable Ranges and Limits

a. Product Composition Standard

MCPA manufacturing-use products are available in a variety of forms: MCPA acid, the dimethylamine salt of MCPA, the isooctyl ester of MCPA, the butyl ester, the butoxyethyl ester of MCPA, and a mixture of the isobutyl, isopropyl, and butyl esters of MCPA. Manufacturing-use MCPA products with any percentage of the above listed acids, salts, or esters are acceptable under this Standard with appropriate certification of limits.

Manufacturing-use products containing amine and alkanolamine salts of MCPA must be analyzed for the presence of N-nitrosamines immediately following manufacture and after storage (see pp. 13 for option of certifying that nitrites are not added). Registrants of products containing nitrosamines in excess of 1 part per million must provide the Agency with a risk analysis (45 FR 42854).

Manufacturing-use MCPA products manufactured with chlorocresols must be analyzed for the presence of chlorinated dioxins, or, alternatively, registrants may provide the Agency with detailed explanations of why the formation of chlorinated dioxins is unlikely to occur in their product(s).

b. Acute Toxicity Limits

The Agency will consider registration of proposed manufacturing-use MCPA products that have established acute toxicity I-IV ratings for each of the following effects:

Acute Oral Toxicity
Acute Dermal Toxicity
Acute Inhalation Toxicity
Primary Eye Irritation
Primary Dermal Irritation

c. Use Patterns

To be covered under this Standard, manufacturing-use MCPA products must be labeled for formulation into end-use products that are intended for outdoor, nondomestic (general) or domestic (restricted), terrestrial or aquatic, food crop or nonfood crop applications.

Under section 180.339 of the Code of Federal Regulations Title 40, tolerances have been established for the use of MCPA in or on barley, flax, flaxseed, grasses, oats, pea vines, rice, rye, sorghum, vegetables (seed and pod), wheat, cattle, goats, hogs, horses, milk, and sheep (see Chapter 7 for full tables of existing tolerances).

Because the Provisional Acceptable Daily Intake (PADI) of MCPA has been exceeded by the theoretical dietary exposure figure, additional tolerances will not be considered under this Standard (see Tolerance Reassessment).

Additional nonfood use patterns of MCPA are acceptable under this standard, provided registrants demonstrate that the new use will not result in unreasonable adverse effects to applicators or the environment. Products intended for domestic use will be restricted use pesticides.

2. Required Labeling

All proposed manufacturing-use products must bear appropriate labeling as specified in 40 CFR 162.10.

3. Tolerance Reassessment

See the Residue Chemistry Chapter of this Standard for full discussions of existing U.S. tolerances and Codex tolerances.

Tolerances for residues of MCPA and of its metabolite 2-methyl-4-chlorophenol have been established for a number of food and feed commodities (see Chapter 7). Certain esters of MCPA are not listed as included in the regulation establishing tolerances for MCPA. 40 CFR 180.339 should be amended to add those esters not now included, i.e., the butyl ester, and the isobutyl and isopropyl esters.

Based on these tolerances, the theoretical maximum residue contribution (TMRC) of MCPA and its metabolite to the human diet is calculated to be ca 0.77 mg/day (assuming a 1.5 kg diet), or .013 mg/kg. The PADI of MCPA in the human diet equals the no-observable-effect-level (NOEL) (4 mg/kg) divided by a 2,000-fold safety factor. The PADI is .002 mg/kg. The provisional maximum permissible intake (PMPI) is the ADI multiplied by 60 kg (the average weight of a human). The PMPI is .12 mg/day.

The theoretical dietary exposure to MCPA is approximately 6 times the maximum permissible intake. A 2,000-fold safety factor is used for the purpose of calculating the PADI and PMPI because the NOEL was established in a subchronic feeding study. It is Agency policy to utilize a 2,000-fold safety factor when NOEL's are based on subchronic data and chronic feeding studies are unavailable.

When the Agency uses the customary safety factor of 100 instead of 2,000, the theoretical dietary exposure level does not exceed the maximum permissible intake.

Because the ADI (based on existing subchronic data) is provisional, pending the receipt of chronic feeding data, the Agency will not take action at this time to revoke any existing tolerances. However, the Agency will also not consider any additional tolerances under this Standard.

B. End-Use MCPA

1. Acceptable Ranges and Limits

a. Product Composition Standard

MCPA end-use products are available in soluble and emulsifiable concentrate formulations. MCPA end-use products contain the sodium salt of MCPA, the diethanolamine salt of MCPA, the dimethylamine salt of MCPA, the isooctyl ester, the butoxyethyl ester, and a mixture of the butyl and isopropyl esters. End-use MCPA products with any percentage of the above-listed salts or esters are acceptable under this Standard with appropriate certification of limits.

End-use products containing amine and alkanolamine salts of MCPA must be analyzed for the presence of N-nitrosamines immediately following manufacture and after storage (see pp. 13 for option of certifying that nitrites are not added). Registrants of products containing nitrosamines in excess of 1 part per million must provide the Agency with a risk analysis (45 FR 42854).

b. Acute Toxicity Limits

The Agency will consider the registration of MCPA end-use products for general nondomestic use or restricted domestic use with established acute toxicity ratings of:

	I	II	III	IV
Acute oral toxicity	Yes	Yes	Yes	Yes
Acute dermal toxicity	Amendment*	Yes	Yes	Yes
Acute inhalation toxicity	Amendment*	Yes	Yes	Yes
Primary eye irritation	Yes	Yes	Yes	Yes
Primary dermal irritation	Yes	Yes	Yes	Yes

* An amendment is required for the registration of products in category I for acute dermal toxicity and acute inhalation toxicity, because dermal and inhalational routes represent the routes with the highest potentials for significant exposure during the mixing and application of liquid formulations.

c. Use Patterns and Application Methods

MCPA end-use products may be used nondomestically and domestically as herbicides in barley, flax, flaxseed, grasses (including turf), oats, pea vines, rice, rye, sorghum, alfalfa, clover, vegetables (seed and pod), and wheat, or in noncrop areas.

2. Additional Uses

Because the Provisional Maximum Permissible Intake (PMPI) of MCPA has been exceeded by the Theorétical Maximum Residue Contribution (TMRC), additional tolerances will not be considered under this Standard (see Tolerance Reassessment).

Additional nonfood use patterns are acceptable under this standard, provided registrants demonstrate that the new use will not pose an unreasonable risk to applicators or to the environment.

3. Required Labeling

General

All end-use products must bear appropriate labeling as specified in 40 CFR 162.10.

Product Chemistry

For some emulsifiable concentrate products, the flash points are between 30° and 150°F. These products must bear the following precautionary statement:

"Do not use or store near heat or open flame."

Environmental Fate

To decrease the likelihood of spray drift, all end-use products must bear the following restriction:

- "Avoid use of small-diameter spray nozzles."

Use Restrictions (see Residue Chemistry Chapter for details)

The following use restrictions are required to provide assurance that the tolerances for meat, fat, meat byproducts, and for milk will not be exceeded:

Small grains, flax, and sorghum:

> "Do not forage or graze meat animals on treated areas within seven days of slaughter."

Additional restrictions:

Products for use on aquatic sites (such as drainage ditch banks) must bear restrictions against use of the product on potable water, water used for irrigating crops, and water containing edible fish or shellfish. Treated water should not be drained into a flowing stream that contains edible fish or shellfish or is a potential source of potable water or irrigation water. In lieu of labeling restrictions, appropriate tolerances for potable water, fish, shellfish, or irrigated crops, may be necessary. Other labeling restrictions may be imposed as the required environmental fate data gaps are filled.

A restriction against the practice of growing crayfish or catfish in treated rice fields is required to preclude the possibility of residues in crayfish or catfish:

> "Do not grow crayfish or catfish in treated rice fields."

For nonfood uses, when the application rate exceeds 2 lbs. a.e./acre (rights of way and fallow lands), the following labeling is suggested:

> "Do not forage or graze livestock on treated areas within seven days of treatment."

CHAPTER III

DATA REQUIREMENTS and DATA GAPS

A. Manufacturing-Use MCPA

1. Generic Data Requirements:

Table A, entitled: Generic Data Requirements and Data Gaps for Manufacturing-Use Products includes those data that pertain to the properties or effects of MCPA as an active ingredient. Thus, these data are relevant to an evaluation of the risks and benefits of all products containing MCPA. Providing data to fill indicated gaps in the data base is the primary responsibility of the registrant(s) of manufacturing-use MCPA. Registrants of end-use products which are not exempted by FIFRA Section 3(c)(2)(D) are also responsible for the submission of these data. To preclude unnecessary studies from being conducted, registrants are strongly urged to consult with appropriate Agency scientists (i.e., Hazard Evaluation Division, Office of Pesticide Programs) before initiating studies. For useful background information, consult the Agency's Guidelines. Applicants for the registration or reregistration of manufacturing-use MCPA products must acknowledge reliance on existing data which fill indicated data requirements under FIFRA Section 3(c)(1)(D). These data are listed under the column entitled Bibliographic Citation in this table.

Environmental Fate Data

Data on physico-chemical degradation, mobility, metabolism, and accumulation are required on MCPA acid AND on each salt and ester of MCPA. Because of the interconvertability between MCPA acid and salt forms, MCPA and its salts can be considered one entity for Environmental Fate testing. This is not the case for MCPA esters. The Agency has no basis for saying that MCPA and its esters are equivalent for testing purposes. Therefore data on the fate of each ester are required. Alternatively, registrants have the option of citing data from analogous chemicals which indicate that a particular ester would be equivalent to MCPA acid under test conditions.

Product Chemistry Data

Certain data on the physical/chemical properties of technical MCPA acid are required for the registration of all salts and esters of MCPA. Additional data specific to particular salts and esters are also required.

Toxicology Data

A full battery of toxicological testing is required on MCPA acid, each salt and each ester. Alternatively, registrants may submit evidence which substantiates that a particular salt or ester will be toxicologically equivalent to MCPA acid.

Ecological Effects Data

Fish and wildlife (ecological effects) safety testing must be conducted on MCPA acid (for the registration of products containing MCPA acid) and on a number of different salts and esters (for the registration of products containing the salts and esters). Separate testing is required because data indicate that the physical/chemical properties (ie. solubility) of the salts and esters differ. These differences could influence the acute toxicity of these compounds to fish and wildlife.

2. Product Specific Data Requirements: Manufacturing-Use MCPA

Table B, entitled: Product Specific Data Requirements for Manufacturing-Use Products includes those data that relate only to the properties or effects of a product with a specific composition (or substantially similar composition). Thus, these data are required of each product (or substantially similar product) to characterize the products's particular composition and physical/chemical properties, and to characterize the products's acute toxicity.

Product composition data are required for each manufacturing-use product. Providing data to fulfill these requirements is the responsibility of each applicant for the registration or reregistration of a manufacturing-use MCPA product. If the Agency has data which fulfills this requirement for a particular product(s) then this is indicated in the chart and in the guidance package accompanying this Standard.

Data on the physical/chemical properties and acute toxicity of manufacturing-use products are required for each product or substantially similar product. Providing data to fulfill these requirements is the responsibility of each applicant for the registration or reregistration of a manufacturing-use MCPA product.

Product specific data need not be acknowledged under FIFRA Section 3(c)(1)(D) unless the Agency or a registrant has established that one product is substantially similar to another product for which the Agency has received acceptable data.

Existing manufacturing-use MCPA products are substantially similar in composition for the purposes of establishing product-specific testing requirements.

Product Chemistry Data

Data requirements 163.61-3 through 163.61-7 apply to each proposed or currently registered manufacturing-use MCPA product.

Toxicology Data

Data requirements 163.81-1 and 163.81-2 (acute oral and dermal toxicity) apply to manufacturing-use products which are not toxicologically equivalent to the technical grade of the active ingredient. Testing is required of each manufacturing-use product. Alternatively, registrants may choose to submit references to existing data on analogous chemicals which substantiate that a particular salt or ester is toxicologically equivalent to MCPA acid.

Data requirements 163.81-3 through 163.81-6 apply to each manufacturing-use product or substantially similar product. Testing must be supplied on MCPA acid and on each manufacturing-use product, unless registrants argue for toxicological equivalence to MCPA acid by citing data on analogous chemicals.

B. End-Use MCPA Products

Applicants for the registration of end-use products containing MCPA are advised that if the Agency does not receive commitments, within the specified time, from manufacturing-use MCPA registrants to fill data gaps identified for the manufacturing-use product, manufacturing-use product registrations will be suspended. Formulators must then bear the burden of supplying these data if continued availability of the manufacturing-use product is desired.

1. Product Specific Data Requirements for End-Use Products

Table C: Product Specific Data Requirements and Data Gaps for End-Use MCPA includes those data that relate only to the properties or effects of products with a specific composition (or substantially similar composition). Thus, these data are required of each product (or substantially similar product) to characterize the product's particular composition and physical/chemical properties, and to characterize the products acute toxcicity.

Product composition data are required for each end-use product. Providing data to fulfill this requirement is the responsibility of each applicant for the registration or reregistration of an end-use MCPA product. If the Agency has data which fulfills this requirement for a particular product(s) then this is indicated in the chart and in the guidance package accompanying this Standard.

Data on the physical/chemical properties and acute toxicity of end-use products are required for each product or substantially similar product. Providing data to fulfill these requirements is the responsibility of each applicant for the registration or reregistration of an end-use MCPA product.

Product-specific data need not be acknowledged under FIFRA Section 3(c)(1)(D) unless the Agency or a registrant has established that one product is substantially similar to another product for which the Agency has received acceptable data.

Substantially Similar Products

Testing of representative products containing each type of registered salt and ester of MCPA is required.

Product Chemistry Data

Data requirements 163.61-3 through 163.61-8 apply to each proposed or currently registered end-use MCPA product.

Toxicology Data

Data requirements 163.81-1 through 163.81-6 apply to representative products containing each type of MCPA salt and ester.

TABLE A

GENERIC DATA REQUIREMENTS AND DATA GAPS FOR MANUFACTURING-USE MCPA[a]

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirements?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)? If So, Deadline for Submission
Product Chemistry						
163.61-3(b)	Product Identify	Yes	Tech Grade*	Yes		No
163.61-3(c)	Product Composition	Yes	Tech Grade*	No		Yes: 6 months
163.61-7	Analytical Methods & Data	Yes	Tech Grade*	Partial: Need data on each product	Harwell, 1978, 00021977 Akzo Zout Chemie, 1971, 00004730 Chipman, 1973, 00021917 Akzo Zout Chemie, 1971, 00004735 Kemisk Vaerk Koge, 1972, 00004576 Gardner, 1960, 05004565 Zweig, 1972, 05005846 Collier, 1974, 05003559 Stevens, 1979, 05012650 Malina, 1971, 05003450	Yes: 6 months
163.61-8(c)(1)	Color	Yes	Tech Grade*	Partial[1]	St. John, 1965, 00004995 CSF: 11636-2 CSF: 11636-3 CSF: 11636-1	Yes: 6 months
163.61-8(c)(2)	Odor	Yes	Tech Grade*	Partial[1]	CSF: 11636-2 CSF: 11636-3 CSF: 11636-1	Yes: 6 months
163.61-8(c)(3)	Melting Point	Yes	Tech Grade**	Partial[2]	St. John, 1965, 00004995 CSF: 11636-2	Yes: 6 months
163.61-8(c)(4)	Solubility	Yes	Tech Grade*	Partial[2]	St. John, 1965, 00004995 CSF: 11636-2	Yes: 6 months
163.61-8(c)(5)	Stability	Yes	Tech Grade*	No		Yes: 6 months
163.61-8(c)(6)	Octanol/Water Partition Coefficient	Yes	Pure Form of A.I***	No		Yes: 6 months
163.61-8(c)(7)	Physical State	Yes	Tech Grade*	Yes	St. John, 1965, 00004495 CSF's of Products	No
163.61-8(c)(8)	Density or Specific Gravity	Yes	Tech Grade*	Partial[1]	St. John, 1965, 00004995 CSF: 11636-2 CSF: 11636-3 CSF: 11636-1	Yes: 6 months
163.61-8(c)(9)	Boiling Point	Yes	Tech Grade Esters	No		Yes: 6 months
163.61-8(c)(10)	Vapor	Yes	Pure Form of A.I.***	No		Yes: 6 months
163.61-8(c)(11)	pH	Yes	Tech Grade*	No		Yes: 6 months

Data requirements are current as of October 1981. See guidance package for updated requirements.

[a] These data are required for the registration of technical chemicals, and for the registration of other products whenever the source of the active ingredient in the product is not registered.

* Data are required on technical grade MCPA acid, technical grade isooctyl ester, technical grade butoxyethyl ester, technical grade butyl ester, technical grade of the mixture of butyl and isopropyl esters, and the technical grade of the mixture of isobutyl, isopropyl and butyl esters of MCPA, and the manufacturing-use products containing the sodium salt, dimethylamine salt and diethanolamine salts of MCPA.

** Data are required on technical grade MCPA acid only.

*** Data are required on the analytically pure form of MCPA acid and each ester.

[1] Data are available on MCPA acid, the isooctyl ester, and the mixed esters.

[2] Data are available on MCPA acid.

TABLE A (continued)

GENERIC DATA REQUIREMENTS AND DATA GAPS
FOR MANUFACTURING-USE MPCA[a]

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirements?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)? If So, Deadline for Submission
Environmental Fate						
163.62-7(b)	Hydrolysis	Yes	Tech Grade[1]	Partial[2]	Soderquist, 1974, 00004448 Soderquist, 1975, 05003445	Yes: 12 months
163.62-7(c)	Photo-degradation	Yes	Tech Grade[1]	Partial[1]	Soderquist, 1974, 00004448 Soderquist, 1975, 05003445	Yes: 12 months
163.62-8(b)	Aerobic Soil Metabolism	Yes	Tech Grade[1]	No		Yes: 10 months
163.62-8(e)	Aerobic Aquatic Metabolism	Yes	Tech Grade[1]	No		Yes: 10 months
163.62-8(d)	Anaerobic Aquatic Metabolism	Yes	Tech Grade[1]	No		Yes: 12 months
163.62-8(f)	Microbial Metabolism	Reserved[4]				
163.62-8(g)	Activated Sludge Metabolism	Reserved[4]				
163.62-9(b)	Leaching	Yes[5]	Tech Grade[1]	Yes	Helling, 1971, 05016652 Helling, 1968, 05004203 Herzel, 1979, 15021216	No
163.62-9(c)	Volatility	Yes	Non-Radio-labeled Material	No		Yes: 10 months
163.62-9(d)	Adsorp./Desorp.	Yes[7]	Tech Grade[1]	No		Yes: 10 months
163.62-9(e)	Water Dispersal	Yes	Rep. Form[7]	No		Yes: 10 months
163.62-10(b)	Terrestrial Field Dissipation Categories 1,3,4,5[9]	Yes	Rep. Form[8]	No		Yes: 12 months
163.62-10(c)	Aquatic Field Dissipation[10]	Yes	Rep. Form[8]	Partial[11]	Frank, 1979, 05019954	Yes: 14 months
163.62-11(b)	Rotational Crops	Yes	Analytical Grade[12]	No		Yes: 26 months
163.62-11(c)	Irrigated Crops	Yes	Rep. Form[8]	No		Yes: 14 months
163.62-11(d)	Fish Accumulation	Yes[13]	Tech Grade[1]	No		Yes: 24 months
163.62-13	Disposal and Storage	Reserved[14]				

Data requirements current as of October 1981. Refer to guidance package for updated requirements.

1 Radio-labeled analytical grade preferred or non-radio-labeled technical grade MCPA acid and each ester. Registrants have the option of testing each ester or of citing data showing that the ester in question would be equivalent to MCPA acid under test conditions.

2 Laboratory studies at acid, neutral, and basic pH at two concentrations and temperatures are needed.

3 Laboratory study using radioisotopic or non-radioisotopic techniques at one concentration under natural or simulated (>290 nm) sunlight

4 The requirement for the submission of these data is currently being reserved pending the completion of Agency testing protocols.

5 For terrestrial noncrop uses, orchard crop uses, field or vegetable crop uses, and forestry uses, the mobility of the test substance and its degradates in soil shall be assessed either by soil thin layer chromatography, soil column, or batch equilibrium (adsorption/desorption) procedures.

7 For domestic outdoor uses, greenhouse uses, aquatic uses, and aquatic impact uses, the mobility of the test substance and its degradates in soil shall be assessed only by the batch equilibrium (adsorption/desorption) procedure.

8 Testing required on representative formulation types.

9 Field and vegetables crops, pasture land, domestic outdoor parks and ornamental/turf use, and rights of way.

10 Aquatic food crops.

11 Additional data needed on MCPA butoxyethyl ester.

12 Radiolabeled analytical grade preferred; if residue found, field testing using representative formulations

13 Flow through only.

14 This data requirement is currently reserved pending completion of applicable Agency guidelines.

TABLE A (continued)

GENERIC DATA REQUIREMENTS AND DATA GAPS
FOR MANUFACTURING-USE MPCA[a]

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirements?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)? If So, Deadline for Submission
Toxicology						
163.81-1	Acute Oral Toxicity	Yes	Tech Grade*	Yes[1]	Raltech, 1977, 000021972	No
163.81-2	Acute Dermal Toxicity	Yes	Tech Grade*	No		Yes: 6 months
163.81-7	Acute Delayed Neurotoxicity	No[2]				
163.82-1	Subchronic Oral Toxicity	Yes	Tech Grade*	Yes	Holsing & Kundzin, ,1970, 00004776 Holsing & Kundzin, 1968, 00004775 Holsing, 1970, 00004756 Holsing, 1970, 00004757	No
163.82-2	Subchronic (21 day) Dermal Tox.	No[1]				
163.82-3	Subchronic (90-day) Dermal Tox.	No[1]				
163.82-4	Subchronic Inhal. Tox.	No[1]				
163.82-5	Subchronic Neurotoxicity	No[1]				
163.83-1	Chronic Feeding	Yes	Tech Grade*	No		Yes: 48 months
163.83-2	Oncogenicity	Yes	Tech Grade*	No		Yes: 48 months
163.83-3	Terato-genicity	Yes	Tech Grade*	No	Palmer & Lovell, 1977, 00004447 Yamada & Maeda, 1972, 05003566 Irvine, 1980, 000041637	No
163.83-4	Reproduction	Yes	Tech Grade*	Partial	Elo& Parvinen, 1976, 05004101	Yes: 12 months
163.84-1-4	Mutagenicity	Yes	Tech Grade*	Partial	Zetterberg, 1979, 05004970 Zetterberg, 1979, 05003571 Magnusson et al, 1977, 05016939 Propping et al, 1971, 05009217 Buselmaier et al, 1972, 0501655	Yes: 24 months
163.85-1	Metabolism	Yes	Tech Grade*	Yes	Bjerke, 1971a, 00004625 Bjerke, 1971b, 00004626 Elo, 1976, 05003256 Gilbert & Hopkins, 1978, 00041634	No
163..86-1	Domestic Animal Safety Testing	No				

a These data are required for the registration of technical chemicals, and for the registration of other products wheneverthe source of the active ingredient in the product is not registered.

* The Agency is requiring a full battery of toxicological testing on technical grade MCPA acid to support the food uses of this active ingredient. The Agency has made a preliminary determination that acute, subchronic and chronic toxicological testing of MCPA acid will provide sufficient information to support the requirements for testing of the technical grade esters of MCPA and each manufacturing-use MCPA salt. Registrants have the option of supplying the full battery of acute, subchronic, and chronic toxicological testing on each technical grade ester or of citing data which show that a particular ester or salt will be equivalent to MCPA acid under test condtions.

1 Testing is available on MCPA acid.

2 Testing of the structurally similar compound, 2,4-D is currently underway. If results are postive, testing of MCPA is required.

3 May be required when acute testing is completed.

TABLE A (continued)

GENERIC DATA REQUIREMENTS AND DATA GAPS
FOR MANUFACTURING-USE MCPA

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirements?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)? If So, Deadline for Submission
Residue Chemistry						
	Metabolism in Plants	Yes	^{14}C-MCPA or Tech Grade	Partial	Sanad, 1971, 05015695 Lallukka, 1974, 05021559 Robertson et al, 1967, 05015046 Aberg et al, 1978, 05019071 Kirkwood et al, 1972, 05004272 Kirkwood et al, 1969, 05015041 Mueller, 1976, 05021735 Fyske, 1975, 05014496 Montgomery, 1970, 00005575 Loos, 1971, 05016100 Fyske, 1976, 05013177 Leafe, 1962, 05005795 Collins et al, 1971, 05003725	Yes
	Metabolism in Animals	Yes	^{14}C-MCPA or Tech Grade	Yes	Bache et al, 1964, 00004701 Leng et al, 1971, 00004622 Matlib et al, 1971, 05015451 Bache et al, 1964, 00004702 Bolencova, 1978, 05017929	No
	Analytical Methods	Yes	Technical or Pure Grade	Partial	Conkin, 1956, 00005552 Yip and Ney, 1966, GS 0017-109 Guardigli, 1970, 00004766 Higham, 1975, 00004633 Higham, 1974, 00004632 St. John, 1967, 00004724 Montgomery, 1970, 00005575 Chow, 1974, 05003765 Guardigli, 1973, 00021920 Guardigli, 1973, 00004287 Gayton,, 1977, 00004822 Guardigli, 1974, 00004787 Herman, 1971, 00004627 Bjerke et al, 1971, 00004625 Bjerke et al, 1971, 00004626 Jensen, 1973, 00004439 Herman et al, 1970, 00004492 Bjerke et al, 1972, 05001259 Miller et al, 1975, 00004438	Yes
	Residue Data: RAC Barley	Yes	Rep Form*	Partial	Higham, 1975, 00005567 Higham, 1975, 00004613 Higham et al, 1975, 00004611 Am. Cyanamid, 1973, 00004741 Am. Cyanamid, 1974, 00004609	No

Flax	Yes	Rep Form*	Yes	Monsanto, 1959, 00004473 Guardigli, 1970, 00004766	No
Grasses, Pastureland and Rangeland	Yes	Rep Form*	Yes	Guardigli, 1971, 00004449	No
Oats	Yes	Rep Form*	Partial	Rydrych et al, 1971, 00023687	No
Rice	Yes	Rep Form*	Yes	Devine, 1970, 00004764 Long et al, 1970, 00004765 Rhodia, 1971, 00004594 Soderquist et al, 1975, 05003445	No
Rye	Yes	Rep Form*	Partial	Data from other small grains applicable to rye.	No
Sorghum	Yes	Rep Form*	Yes	Interregional, 1974, 00004491	No
Seed & Pod Vegetables	Yes	Rep Form*	Yes	Conkin, 1955, 00005552 Chow et al, 1965, 05001765 Winterlin et al, 1974, 00004451 Bendixen, 1974, 00004454 Guardigli, 1974, 00004788	No
Wheat	Yes	Rep Form*	Yes	Yip and Ney, 1966, GS 0017-109 Montgomery, 1970, 00005575 Rydrych et al, 1971, 00023687 Higham et al, 1974, 00005570	No
Residues in Food Producing Animals	Yes	Rep Form*	Yes	Bjerke et al, 1971, 00004625 Jensen et al, 1973, 00004439 Bjerke et al, 1971, 00004626 Bache et al, 1964, 00004701 Herman et al, 1970, 00004491 Bjerke et aa, 1972, 00003259 Herman et al, 1971, 00004624 Duggan et al, 1967, 00025154 Bache et al, 1964, 00004702	No[2]
Residue in Processed Foods	Yes	Rep Form*	Partial	00004766 00004765	No[1]
Storage Stability	Yes	Rep Form*	No		No[3]

* From applications of representative formulations.

[1] There being little, if any residues in those raw agricultural commodities from which processed commodities may be derived, the need for further data on residues in the latter is waived.

[2] There being little, if any residue in grains, a staple of poultry rations, the need for data on residues in poultry and eggs is waived.

[3] Information obtained from individual studies indicates that the analysis of samples was generally performed within a few months, and generally not later than 6 months after sampling. Under the circumstances, the need for residue storage data is waived.

TABLE A (continued)

GENERIC DATA REQUIREMENTS AND DATA GAPS
FOR MANUFACTURING-USE MCPA[a]

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirements?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)? If So, Deadline for Submission
Ecological Effects						
163.71-1	Avian Single Dose Oral LD_{50}	Yes	Tech Grade[1]	No		Yes: 6 months*
163.71-2	Avian Dietary LC_{50}	Yes	Tech Grade[2]	Yes	DeWitt, GS 0017-101	No
163.72-1	Fish Acute LD_{50}	Yes	Tech Grade and 1 end-use product[3]	Partial[4]	USEPA, GS 0017-108	Yes: 6 months
163.72-2	Acute Tox. to Aquatic Invertebrates	Yes	Tech Grade and 1 end-use product[5]	Partial[4]	USEPA, GS 0017-108	Yes: 6 months
163.72-3	Acute Tox. to Estuarine & Marine Organisms	Yes	Tech Grade and 1 end-use product[6]	No		Yes: 6 months

Data requirements current as of October 1981. See guidance package for updated requirements.

* 24 months after promulgation of Subpart J

[a] These data are required for the registration of technical chemicals, and for the registration of other products whenever the source of the active ingredient in the product is not registered.

[1] Testing required in one avian species (preferably mallard duck or bobwhite quail) using technical grade MCPA acid and isooctyl and butoxyethyl esters, and the manufacturing-use products containing the sodium and dimethylamine salts.

[2] Testing in required on one species of waterfowl (preferably mallard duck) and one species of upland game bird (preferably bobwhite quail or ring-necked pheasant) using technical butoxyethyl and isooctyl esters, and the manufacturing-use products containing the sodium and dimethylamine salts.

[3] Testing in bluegill sunfish and rainbow trout is required with technical MCPA acid, the butoxyethyl ester, and the isooctyl ester and the manufacturing-use products containing the dimethylamine salt. Testing of the 66.7% butoxyethyl ester end-use formulation is also required because of its use in rice.

[4] Available data fulfill requirements for MCPA acid.

[5] Testing is required in *Daphnia magna* for the 66.7% butoxyethyl ester end-use product. Aquatic invertebrate testing is also required on MCPA acid.

[6] Testing is required on technical MCPA acid, the butoxyethyl ester, and the isooctyl ester, and the manufacturing-use products containing the dimethylamine salt. Testing in shrimp and fish, and , either oyster larvae testing or mollusc shell deposition testing with the 66.7% butoxyethyl ester formulation is required.

TABLE B

PRODUCT-SPECIFIC DATA REQUIREMENTS AND DATA GAPS
FOR MANUFACTURING-USE MCPA*

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirements?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)? If So, Deadline for Submission
Product Chemistry						
163.61-3	Product Identify and Disclosure of Ingredients	Yes	Each MUP**	Partial[1]	CSF's[2]	Yes: 6 months
163.61-4	Description of Mfg Process	Yes	Each MUP**	No		Yes: 6 months
163.61-5	Disc. of Format of Unint. Ingredients	Yes	Each MUP**			Yes: 6 months
163.61-6	Declaration of Ingredient Limits	Yes	Each MUP**			Yes: 6 months
163.61-7	Product Analyt. Data	Yes	Each MUP**	Partial[3]		Yes: 6 months
163.61-8(c)(7)	Physical State	Yes	Each MUP**	Yes	St. John, 1965, 00004995 CSF: 11636-2 CSF: 11636-3 CSF: 11636-1	No
163.61-8(c)(8)	Density or Specific Gravity	Yes	Each MUP**	Partial[1]	St. John, 1965, 00004995 CSF: 11636-1 CSF: 11636-2 CSF: 11636-3	Yes: 6 months
163.61-8(c)(11)	pH	Yes	Each MUP**	No		Yes: 6 months
163.61-8(c)(12)	Storage Stab.	Yes	Each MUP**	No		Yes: 6 months
163.61-8(c)(13)	Flammability	Yes	Each MUP**	Partial[1]	CSF 11636-1 thru 3	Yes: 6 months
163.61-8(c)(14)	Oxidizing Reducing Action	Yes	Each MUP**	No	CSF: 11636-2 CSF: 11636-3	Yes: 6 months
163.61-8(c)(15)	Explosiveness	Yes	Each MUP**	No		Yes: 6 months
163.61-8(c)(16)	Miscibility	Yes	Each MUP**	No		Yes: 6 months
163.61-8(c)(17)	Viscosity	Yes	Each MUP**	No		Yes: 6 months
163.61-3(c)(18)	Corrosion Characteristics	Yes	Each MUP**	No		Yes: 6 months

* Data are required for the registration of each manufacturing-use product. For currently registered products.

** Required for each manufacturing-use product.

[1] Data are available on MCPA acid, the isooctyl ester, and the mixed esters.

[2] Updated statements are required for all manufacturing-use products.

[3] Satisfactory methods are available (See Table A) but data are required on each manufacturing-use product.

TABLE B (continued)

PRODUCT-SPECIFIC DATA REQUIREMENTS AND DATA GAPS
FOR MANUFACTURING-USE MCPA[a]

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirements?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)? If So, Deadline for Submission
Toxicology						
163.81-1	Acute Oral Toxicity	Yes	MUP**	Yes[1]	Raltech, 1977, 000021972	No
163.81-2	Acute Dermal	Yes	MUP**	No		Yes: 6 months
163.81-3	Acute Inhal Toxicity	Yes	MUP***	No		Yes: 6 months
163.81-4	Prim Eye Irritation****	Yes	MUP***	Yes[2]	Raltech 1977, 00021974	No
163.81-5	Prim Dermal Irritation	Yes	MUP***	No		Yes: 6 months
163.81-6	Dermal Sensitization	Yes	MUP***	No		Yes: 6 months

* For currently registered products.

** Required for manufacturing-use products which are not the same as the technical grade of the active ingredient. The Agency has made a preliminary determination that testing on technical MCPA acid will support this requirement for testing of the technical grades of the esters and manufacturing-use salts (see Table A). Acute toxicity testing of each manufacturing-use product (or substantially similar product) which is not equivalent to the technical grades of the active ingredients is required.

*** Required for each manufacturing-use product or substantially similar product.

**** A demonstration of pH between 1 and 3, or 12 and 14 or demonstration of dermal irritation will be sufficient to categorize a product as an ocular irritant, and additional testing will not be required.

[1] Available testing is on technical grade MCPA acid.

[2] Available testing is on a sodium salt end-use formulation. This testing indicates that this product is a Category I eye irritant. Registrants have the option of accepting this classification for their product(s) or of providing actual testing of each product (or substantially similar product).

TABLE C

PRODUCT-SPECIFIC DATA REQUIREMENTS AND DATA GAPS FOR MANUFACTURING-USE MCPA#

Guideline Citation	Name of Test	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirements?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)? If So, Deadline for Submission
Product Chemistry						
163.61-3	Product Identity & Disclosure of Ingredients	Yes	Each E.U. Product**	Partial[1]	CSF's	Yes: 6 months
163.61-6	Declaration of Ingredient Limits	Yes	Each E.U. Product**	No		Yes: 6 months
163.61-7	Product Analyt Methods & Data	Yes	Each E.U. Product**	Partial[2]		Yes: 6 months
163.61-8(c)(1)	Color	Yes	Each E.U. Product**	No		Yes: 6 months
163.61-8(c)(2)	Odor	Yes	Each E.U.	No		Yes: 6 months
163.61-8(c)(7)	Physical State	Yes	Each E.U.	Yes	CSF's and Labels	Yes: 6 months
163.61-8(c)(11)	pH	Yes	Each E.U. Product**	Partial[4]		Yes: 6 months
163.61-8(c)(12)	Storage Stab.	Yes	Each E.U. Product**	Partial[5]	Wirth & Manro, 1977, 00005577	Yes: 6 months
163.61-8(c)(13)	Flamma bility	Yes	Each E.U. Product**	Partial[6]		Yes: 6 months
163.61-8(c)(14)	Oxidizing or Reducing Action	Yes	Each E.U. Product**	No		Yes: 6 months
163.61-8(c)(15)	Explosive-ness	Yes	Each E.U. Product**	No		Yes: 6 months
163.61-8(c)(16)	Miscibility	Yes	Each E.U. Product**	No		Yes: 6 months
163.61-8(c)(17)	Viscosity	Yes	Each E.U.	No		Yes: 6 months
163.61-8(c)(18)	Corrosion Characteristics	Yes	Each E.U. Product**	Partial[5]	Wirth & Manro, 1977, 00005577	Yes: 6 months

# These data are required for the registration of end-use MCPA products.

* For currently registered product

** Each end-use MCPA Product

1 Updated statements are required for each product.

2 Satisfactory methods are available (see Table A) but data are required on each end-use product.

3 See: "Product Chemistry: End-Use Formulations" for listing of available data on the densities of currently registered products

4 See: "Product Chemistry: End-Use Formulations" for listing of available data on the pH's of currently registered products.

5 Data are available on a dimethylamine amine salt formulation (464-194).

6 See: "Product Chemistry: End-Use Formulations" for listing of available data on the flamma bility of currently registered products.

TABLE C (continued)

PRODUCT-SPECIFIC DATA REQUIREMENTS AND DATA GAPS
FOR MANUFACTURING-USE MCPA[a]

Guideline Citation	Name of Test *	Are Data Required?	Test Substance	Does EPA Have Data to Partially or Totally Satisfy Requirements?	Bibliographic Citation	Must Additional Data be Submitted Under FIFRA 3(c)(2)(B)? If So, Deadline for Submission
Toxicology						
163.81-1	Acute Oral Toxicity	Yes	E.U. Product[1]	Partial[2]	Gurd, 1964, 00022569 Gurd et al, 1964, 00022568	Yes: 6 months
163.81-2	Acute Dermal Toxicity	Yes	E.U. Product[1]	Partial[3]	Raltech, 1977, 00021973	Yes: 6 months
163.81-3	Acute Inhal. Toxicity	Yes	E.U. Product[1]	Partial[3]	Biesemiar & Angevine, 1979, 00021975	Yes: 6 months
163.81-4	Prim. Eye Irritation	Yes	E.U. Product[1]	Partial[4]	Raltech, 1977, 00021974 Gabriel, 1971, 00004513	Yes: 6 months
163.81-5	Prim. Dermal Irritation	Yes	E.U. Product[1]	Partial[3]	Raltech, 1977 00021976	Yes: 6 months

* For currently registered products.

[1] Testing required of each end-use product or substantially similar product. The Agency has made a preliminary determination that; soluble concentrates containing the sodium, salt are substantially similar; that soluble concentrate products containing the dimethylamine salt are substantially similar; that soluble concentrate products containing the diethanolamine salt are substantially similar; that emulsifiable concentrate products containing the butoxyethyl ester are similar; that emulsifiable concentrates containing the isooctyl ester are similar; and that emulsifiable concentrates containing mixtures of the butyl and isopropyl esters are similar.

[2] Available data on: 2 lb/gal. soluble concentrate containing the sodium salt and a soluble concentrate containing the diethanolamine salt.

[3] Available data on a 2 lb/gal. soluble concentrate containing the sodium salt.

[4] Available data on the 2 lb/gal. sodium salt formulation indicate that this product is a severe irritant. Registrants have the option of accepting this classification for their product(s), or of providing specific testing. Data were also available on an emulsifiable concentrate containing the butoxyethyl ester.

CHAPTER IV
MCPA PRODUCT CHEMISTRY

A. Introduction

FIFRA 3(c)(2)(A) requires the Agency to establish guidelines for registering pesticides in the United States. The Proposed Guidelines require registrants to provide quantitative data on all active and added inert ingredients, and on impurities that are equal to or greater than 0.1 percent of the product by weight.

To evaluate the composition of products proposed for registration, the Agency requires data and information not only on the manufacturing and formulation processes, but also a discussion on the formation of manufacturing impurities and other product ingredients, intentional and unintentional. Further, to assure that the composition of the product as marketed will not vary from the composition evaluated at the time of registration, applicants are required to submit a statement certifying upper and lower composition limits for the active and inert ingredients, and upper limits only for some unintentional ingredients. Subpart D of the Proposed Guidelines (40 FR 29696, July 10, 1978) suggests specific precision limits for ingredients based on the percentage of ingredients and the standard deviation of the analytical method.

In addition to the data on product composition, the Agency guidelines also require data on the physical and chemical properties of both the herbicidal active ingredient and its formulations. For example, data are needed concerning the identity and physical state of the active ingredient, such as melting point and boiling point data, ambient vapor pressure, and solubility. Data are also required on the properties of the formulated product to establish labeling precautionary statements (e.g., flammability, corrosiveness, or storage stability). The Agency uses these data to characterize the herbicide and to determine its environmental and health hazards.

Product Chemistry: Manufacturing-Use MCPA

Product Chemistry Profile

MCPA is the common name for 4-chloro-2-methylphenoxyacetic acid. Manufacturing-use and end-use products are marketed under the trade names Mephanac^R, Methoxone^R, Agroxone^R, MCP^R, and Weedar^R. MCPA manufacturing-use products are available in a variety of forms, including the technical acid, the dimethylamine salt, the isooctyl ester, the butyl ester, the butoxyethyl ester, and a mixture of the isopropyl, isobutyl, and N-butyl esters. In this Standard, MCPA refers to the undissociated acid. Esters and salts of MCPA are identified as such.

Manufacturing-use MCPA acid contains a minimum of 35% 4-chloro-2-methylphenoxyacetic acid. The dimethylamine manufacturing-use product contains a minimum of 64% active ingredient. The isooctyl ester manufacturing-use products contain a minimum of 96% active ingredient. The butoxyethyl manufacturing-use products contain a minimum of 97% active ingredient, the butyl ester contains a minimum of 97% active ingredient, and the manufacturing-use product, containing a mixture of esters, contains 47.5% isopropyl ester, 28.5% isobutyl ester, and 19% N-butyl ester.

Pure MCPA is a white, crystalline powder with a melting point of 118°-119°C and a bulk density of 0.7768 gm/cc. MCPA is only slightly soluble in water, but very soluble in ethanol and ethyl ether. Manufacturing-use MCPA salts are highly water-soluble, and manufacturing-use MCPA esters tend to be insoluble in water. The MCPA salts are less volatile than the esters.

Detailed manufacturing processes have not been submitted for currently registered manufacturing-use products. Some published procedures for the manufacture of MCPA use chlorocresols as starting or intermediate materials. Because chlorinated phenols are dioxin precursors under certain conditions, the Agency is requiring registrants of technical MCPA acid and integrated end-use products manufactured with chlorocresols to analyze the product(s) for chlorinated dioxins or, alternatively, to explain in detail why chlorinated dioxins are unlikely to be found in the product(s).

Amine and alkanolamine salts of phenoxyacetic acids may contain nitrosamines as a result of (1) nitrosame contamination of the amines or alkanolamines used to produce the salts, or (2) addition of nitrite to the product to inhibit corrosion during storage. Each registrant of a product containing an amine or alkanolamine salt of MCPA is required to analyze the product immediately after manufacture and after storage. In lieu of analyses on stored products, registrants may certify that nitrosating agents are not added to the product after manufacture.

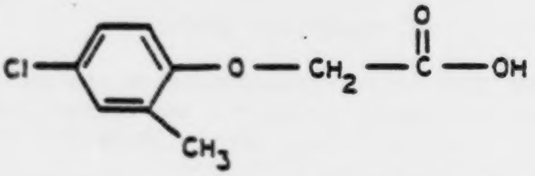
For many products, Confidential Statements of Formula have not been submitted or are outdated, incomplete, or contain errors. Although satisfactory methods for the product analysis of MCPA and associated impurities are available, analytical data have not been submitted by any registrant.

Topical Discussions

Chemical Identity

MCPA (Figure 1) is the common name for the chemical 4-chloro-2-methylphenoxyacetic acid. Alternative chemical names for MCPA include 2-methyl-4-chlorophenoxyacetic acid and [(4-chloro-o-tolyl)oxy] acetic acid. MCPA is also known by many trade names including Mephanac^{R}, Methoxone^{R}, Agroxone^{R}, MCP^{R}, and Weedar^{R}. The Chemical Abstracts Registry (CAS) number for MCPA is 94-74-6, and the EPA Shaughnessy Number is 030501. The common name will be used throughout this standard in lieu of other chemical or trade names.

The chemical formula is C_9H_9,ClO_3, and the molecular weight is 200.62. The structural formula is:



2-Methyl-4-chlorophenoxyacetic acid

Figure 1

In this standard, "MCPA" refers only to the undissociated acid. Salts and esters are identified as such.

Manufacturing Process

Process descriptions submitted by registrants are considered Confidential Business Information and are discussed in the Confidential Appendix.

Processes for the manufacture of technical MCPA have been submitted to the Agency by two producers. Neither of the process descriptions is sufficiently detailed to satisfy Guidelines requirements.

Discussion of the Formation of Unintentional Ingredients

No registrant of a product containing MCPA or an MCPA derivative has submitted a discussion of the formation of unintentional ingredients in the product as required by the Guidelines (163.61-5).

Some published procedures for the manufacture of MCPA use chlorocresols as starting or intermediate materials (Synerholm and Zimmerman, 1945, 05003614; Talbot, 1949, 05020338; Talbot, 1952, 05020337). Because chlorinated phenols are dioxin precursors under certain conditions, the Agency requests that each registrant of technical MCPA manufactured with chlorocresols analyze the product for chlorinated dioxins or, alternatively, explain in detail why chlorinated dioxins are unlikely to be found in the product.

Amine and alkanolamine salts of phenoxyacetic acid may contain nitrosamines as a result of (1) nitrosamine contamination of the amines or alkanolamines used to produce the salts or (2) addition of nitrite to the product to inhibit corrosion during storage. Samples of an amine salt formulation of MCPA obtained "off-the-shelf" contained up to 0.7 ppm N-nitrosodimethylamine (Cohen et al., 1978, 0506328). Each registrant of a product containing an amine or alkanolamine salt of MCPA is requested to analyze the product for nitrosamines immediately after manufacture and after storage. In lieu of analyses of the stored product, a registrant may certify that nitrosating agents are not added to the product after manufacture.

Some data on nitrosamines in amine salts of MCPA have been submitted by Fallek-Lankro (Song, 1977, 00021962; Paudler, 1979, 00021979 - see Confidential Appendix). However, specific data are needed on each product.

Declaration and Certification of Ingredient Limits

For no product containing MCPA or an MCPA derivative has the registrant of the product established upper and lower limits for the active ingredient and each intentionally added inert ingredient, and upper limits for each identifiable impurity as required by the Guidelines (163.61-6).

Product Analytical Methods and Data

Fallek-Lankro (Harwell, 1978, 00021977), Akzo Zout Chemie (1971, 00004730), and Chipman (1973, 00021917) have submitted GLC methods by which MCPA and phenoxyacetic acid impurities in technical MCPA and in formulations are determined as their méthyl esters. A spectrophotometric method for the determination of chlorophenol in MCPA-containing products has been submitted (Akzo Zout Chemie, 1973, 0004735). The method will determine chlorophenols down to 0.02% of the product weight. Kemisk Vaerk Koge (1972, 00004576) has submitted a combined titrimetric-GLC method for the analysis of products containing MCPA esters.

Various product analytical methods for MCPA and associated impurities have been described in the literature, including GLC (Gardner and Overton, 1960, 05004565; Zweig and Sherma, 1972, 05005846; Collier and Grimes, 1974, 05003559), high-pressure liquid chromatography (Stevens and Grorud, 1979, 05012650), and infrared spectrophotometry (Malina 1971, 05003450).

Although satisfactory methods for the product analysis of MCPA and associated impurities are available, analytical data required by section 163.61-7 of the Guidelines have not been submitted by any registrant of an MCPA-containing product.

Physical and Chemical Properties

St. John (1965, 00004995) reports the physical and chemical properties of purified MCPA as:

Color	white	
Melting point	118°-119°C	
Solubility	ethanol	153
(gm/100 gm solvent	ethyl ether	77
at 25°C	toluene	6.0
	xylene	5.0
	N-heptane	0.5
	water	0.15
Physical state:	crystalline powder or flakes	
Bulk density:	0.7768 gm/cc	

The pK_a of MCPA has been variously reported as 3.09, by potentiometric titration (Nelson and Faust, 1969, 05002356); 3.11, by a conductimetric method (Matell and Lindenfors, 1957, 05004185); and 3.13, by a spectrophotometric method (Cessna and Grover, 1978, 05004844).

Some physical and chemical properties of technical MCPA and MCPA esters have been submitted by registrants. The data were submitted in conjunction with Confidential Statements of Formula.

	MCPA (acid) (Reg. No. 11636-2)	Isooctyl ester (Reg. No. 11636-3)	Mixed esters (Reg. No. 11636-1)
Color:	light brown	clear brownish	clear brownish
Odor:	phenolic	pleasant, fresh	pleasant, fresh
Melting Point:	115°C	—	—
Solubility in Water:	≤825 ppm at 15°C	insoluble	insoluble
Physical State:	small flakes	liquid	liquid
Density or Specific Gravity:	0.6 gm/cc	1.0 at 20°C	1.0 at 20°C
Bulk Density:	37.4 lbs./ft^3		
Flammability:	not flammable	100°C	70°C

Summary of Major Data Gaps

No registrant of a product containing MCPA or an MCPA derivative has submitted a detailed manufacturing process, a discussion of the formation of unintentional substances in the product, a declaration and certification of ingredient limits, or analytical data on the product. For many products, Confidential Statements of Formula (EPA Form 8570-4) have not been submitted, are outdated, are incomplete, or contain errors. Some inert ingredients in food-use formulations have not been cleared for such use under 40 CFR 180.1001. Data on numerous physical and chemical properties have not been submitted.

Labeling Requirements

Ingredient Statement. The ingredient statement for manufacturing-use MCPA will list the active ingredient as:

2-methyl-4-chlorophenoxyacetic acid .... M% (min.)

The ingredient statement for manufacturing-use containing MCPA derivatives will list the active ingredient and the equivalent percentage of MCPA, for example:

2-methyl-4-chlorophenoxyacetic acid, sodium salt ...... M% (min.)
(Equivalent to M% of 2-methyl-4-chlorophenoxyacetic acid)

Product Chemistry: End-Use Formulations

Product Chemistry Profile

End-use MCPA products are available in emulsifiable and soluble concentrate formulations. End-use products contain a variety of forms of MCPA, including the sodium salt of MCPA, the diethanolamine salt of MCPA, the dimethylamine salt of MCPA, the isooctyl ester of MCPA, the butoxyethyl ester of MCPA and a mixture of the butyl and isopropyl esters of MCPA.

Few data were available on the physical/chemical properties of any end-use product. Some data on the pH, density, and flammability of particular end-use products are available (see topical discussions). Because the flash points of several emulsifiable concentrates (the esters) range between 80° and 150°F, special labeling is required for these products.

Amine and alkanolamine salts of phenoxyacetic acids may contain nitrosamines as a result of (1) nitrosamine contamination of the amines or alkanolamines used to produce the salts or (2) addition of nitrite to the product to inhibit corrosion during storage. Each registrant of a product containing an amine or alkanolamine salt of MCPA is required to analyze the product immediately after manufacture and after storage. In lieu of analyses on stored products, registrants may certify that nitrosating agents are not intentionally added to the product after manufacture.

For many products, Confidential Statements of Formula have not been submitted or are outdated, incomplete, or contain errors. Although satisfactory methods for the product analysis of MCPA and associated impurities are available, analytical data have not been submitted by any registrant.

Topical Discussions

Chemical Identity

End-use products formulated as soluble concentrates contain the sodium salt of MCPA, the diethanolamine salt of MCPA, or the dimethylamine salt of MCPA. End-use products formulated as emulsifiable concentrates contain the dimethylamine salt of MCPA, the isooctyl ester of MCPA, the butoxyethyl ester of MCPA, or a mixture of butyl and isopropyl esters. The dimethylamine salt formulations are the most frequently used products.

Active Ingredients in Pesticide Products

Product concentrations of MCPA acid equivalent range from 1 to 4 pounds acid equivalent per gallon of product, with the 4-pounds-per-gallon measure being the most common.

For no product containing an MCPA derivative has the registrant of the product established upper and lower limits for the active ingredient and each intentionally added inert ingredient, and upper limits for each identifiable impurity as required by the Guidelines (163.61-6).

Product Analytical Methods and Data

See discussion in Manufacturing-use section for details on acceptable analytical methods. Analytical data have not been submitted by any registrant.

Physical and Chemical Properties

EPA Registration Number	Density	pH	Flammability
Dimethylamine Salts			
148-1120	9.38	—	—
228-143	9.39	7.5	—
264-47	9.403	—	—
359-365	9.38	7.5-8.0	—
464-394	9.4	9.0-9.5	190°F TOC
524-80	9.358	7.4	>200°F TCC
554-60	9.37	8.0-9.0	—
677-298	9.47	6.8-7.2	—
802-138	8.79	—	—
1386-587	9.4	—	—
1685-61	8.58	—	—
39335-7	9.55	7.5	—
39511-65	9.4	—	—
Sodium Salts			
264-55	9.212	—	—
359-170	9.35	8.0-8.5	—
802-374	9.19	—	—
39335-6	9.413	8.0	—
Diethanolamine Salts			
554-123	9.898	8.0-8.6	—
Isooctyl Esters			
359-554	8.3	—	168°F
554-125	8.5056	—	133°F TOC
39511-76	8.51	—	125°F
Butoxyethyl Esters			
264-240	8.971	—	—
Mixed Esters			
554-91	8.308	—	129°F TOC

Labeling Requirements

The ingredient statement for end-use products containing MCPA derivatives will list the active ingredient and the equivalent percentage of MCPA, for example:

2-methyl-4-chlorophenoxyacetic acid, sodium salt .... M% (min.)
(Equivalent to M% of 2-methyl-4-chlorophenoxyacetic acid)

Physical Hazard Precautionary Labeling

The flash points of some emulsifiable concentrates of MCPA esters are between 80° and 150°F and labels on these products are therefore required to bear the following flammability warning [40 CFR 162.10(h)(2)(iii)(B)]:

"Do not use or store near heat or open flame."

CHAPTER V

ENVIRONMENTAL FATE OF MCPA

Introduction

Data on the fate of a pesticide once it enters the environment are required to predict and estimate any potentially harmful effects on man and the environment. The fate of pesticide depends on its formulation type, application methods or use patterns and its chemical, physical, and biological behavior in the environment.

Environmental studies from which data are required include physical and chemical degradation, metabolism, field dissipation, and accumulation.

MCPA is available in soluble and emulsifiable concentrate formulations. These formulations contain a variety of salts and esters of MCPA including the sodium salt of MCPA, the dimethylamine salt of MCPA, the diethanolamine salt of MCPA, the isooctyl ester of MCPA, and the butoxyethyl ester of MCPA. MCPA acid, the dimethylamine salt of MCPA, the isooctyl ester, the butyl ester, the butoxyethyl ester, and a mixture of the isobutyl, isopropyl, and butyl esters are registered manufacturing-use products. The Agency requires data on the fate of MCPA acid in the environment, and data on the fate of each salt and ester found in end-use products.

Because of the interconvertability of MCPA acid and salt forms, MCPA acid and its salts may be considered as one entity for Environmental Fate testing requirements.

For MCPA esters, the situation is different. The Agency has no data on the rates of hydrolysis of MCPA esters in living or nonliving systems. The Agency has no basis for assuming that MCPA esters are equivalent to MCPA acid for testing purposes. Therefore, registrants of manufacturing-use MCPA esters and registrants of integrated end-use products containing unregistered technical esters, must provide testing on each ester, or, cite available data showing that a particular ester would be equivalent to MCPA acid under test conditions. Data on analogous chemicals (e.g. 2,4-D) would be acceptable.

Use Profile

MCPA is a phenoxy herbicide used on a variety of crop and non-crop sites to control a wide spectrum of broadleaf weeds. MCPA is formulated as 1-4 pound(s) per gallon emulsifiable concentrates and soluble concentrates. There are 62 products containing MCPA as the sole active ingredient (SAI) registered with EPA. The forms of MCPA available as SAI are MCPA acid, sodium salt, diethanolamine salt, dimethylamine salt, isoocytl ester, butyl ester, and butoxyethyl ester. The dimethylamine salt is the most frequently used formulation. The salts are highly water soluble while the esters are not water soluble but are readily mixed. Table 5-1 presents the forms, formulations and number of products containing MCPA that are registered with EPA.

Table 5.1 MCPA Formulations and Products

Form	Formulations	Pounds acid equivalent per gallon	Total Number of Products	Manufacturing Products
MCPA (acid)			8	8
Sodium Salt	SC*	2	8	0
Diethanolamine salt	SC	4	2	0
Diethylamine salt	SC	1	1	
" "	SC	5	1	1
" "	SC or EC*	4	27	
Isooctylester	EC or SC*	4	8	4
Butylester	EC	-	1	1
Butoxyethyl ester	EC	4	3	2
(Mixture) Butyl and Isopropyl esters	EC	4	1	2
(Mixture) Isobutyl, Isopropyl, and Butyl esters			2	2

* SC = soluble concentrate
EC = emulsifiable concentrate

Based on the preliminary quantitative usage analysis prepared by EPA economists, the net domestic supply of MCPA for 1979 was estimated at 3.25 to 3.70 million pounds. The majority of MCPA produced in the U.S. (55 to 65%) is used on wheat grown in the Plains States. The second largest use (12 to 14%) is on rice in California. These two sites, in addition to the other small grains (barley, oats, rye), comprise 85 to 95% of MCPA annual usage. Other sites for which MCPA use is registered are: alfalfa, clover, flax, grasses (grown for seed), non-crop areas, pastures, peas, rangeland, grain sorghum, and turf. MCPA is used domestically on home lawns. Table 5-2 presents use information.

Most MCPA is applied postemergence by farmers or professional applicators. Application is usually made by fixed-boom ground rig sprayers in 10 to 30 gallons of water per acre. MCPA is also applied aerially in 2 to 10 gallons of water per acre, primarily on rice. Application of MCPA is subject to the same kinds of state restrictions as other phenoxy herbicides. These restrictions are designed to reduce drift and off-target movement by

Table 5-2. Pesticidal Uses of MCPA

Use Sites	EUP Formulations	Season or Crop Growth Stage	Application			Number of Treatments/ Intervals	Common Tank Mixes	Notes and Limitations
			Type	Equipment	Rate			
Small grains - oats, barley, rye, wheat	All	Apply after crop has reached 3 or 4 leaf stage up to boot stage.	Postemergent broadcast	Aerial or ground rig sprayers	0.125 to 1.5 lbs. active ingredient per Acre	1 per crop	With dicamba, bromoxynil, picloram	Application rate depends on nature of weeds; average rate is about 0.5 lbs.
Small grains with legumes (clover or alfalfa)	Sodium and amine salts	Apply after cereal is well-tillered and before boot stage.	Postemergent broadcast	Aerial or ground rig sprayers	0.125 to 0.5 lbs. ai/A	1 per crop	None	Legume should be protected from herbicide by grain or weed cover. Apply in not more than 5 to 10 gal. of water per acre.
Rice	Sodium and amine salts, butoxyethanol esters	Apply at midseason 35 to 65 days after seeding.	Postemergent broadcast	Aerial	0.75 to 1.5 lbs. ai/A	1 per crop	None	Field should be flooded with 2 to 3" of water. Air temperature should be below 90 F.

Table 5-2. Pesticidal Uses of MCPA

Use Sites	EUP Formulations	Season or Crop Growth Stage	Application			Number of Treatments/ Intervals	Common Tank Mixes	Notes and Limitations
			Type	Equipment	Rate			
Flax	All	Apply when flax has at least 3 or 4 leaves and before it comes into bud.	Postemergent broadcast	Aerial or ground rig sprayers	0.125 to 0.75 lbs. ai/A	1 per crop	With TCA, dalapon	
Clover and Alfalfa	Sodium and amine salts	Apply in fall after frost when legumes are fully dormant.	Postemergent broadcast	Ground rig sprayers	0.125 to 0.5 lbs. ai/A	1 per crop	None	Treatment air temperature should be above above 40 degrees F.
Grasslands and Seed Grasses	All	Apply when weeds are actively growing; before grass boot stage.	Postemergent broadcast	Aerial or ground rig sprayers	0.5 to 1.5 lbs. ai/A	Repeat as needed		Grass for seed is treated at lower application rates and treated before boot stage to avoid seed blast.
Peas (field or green)	Sodium or amine salts	Apply no later than 3 nodes before first pea flowering (spring).	Postemergent broadcast	Ground rig sprayers, some some aerial	0.125 to 0.375 lbs. ai/A	1 per crop	None	Do not spray peas stressed from lack of moisture.

Table 5-2. Pesticidal Uses of MCPA

Use Sites	EUP Formulations	Season or Crop Growth Stage	Application			Number of Treatments/ Intervals	Common Tank Mixes	Notes and Limitations
			Type	Equipment	Rate			
Sorghum	Sodium salt	Apply when crop is 6 to 12" but before boot stage. Weeds should be less than 5" tall.	Postemergent broadcast	Aerial or ground rig sprayers	0.75 lbs. ai/A	1 per crop	None	Sorghum hybrids vary in their tolerance to MCPA. Use of a surfactant may increase chance of crop injury.
Turf	Sodium or amine salt	Apply when weeds are actively growing (best in spring or fall).	Postemergent broadcast	Ground rig sprayers and knapsack sprayers	0.5 to 2.0 lbs. ai/A	Repeat as necessary		Do not mow within 2 days before or after application.
Noncrop such as: fallowland, farm premises, fencerows, commercial/ industrial site, parks, forest chaparral, shelter belts, timberlands, roadsides and rights-of-way	All	Apply when weeds are actively growing.	Postemergent broadcast or directed spray	Mostly fixed ground rig sprayers or hand-directed sprayers, some aerial	0.125 to 3.0 lbs. ai/A (depends on weed)	Repeat as necessary	With picloram	For control of whitebrush add 1 gallon diesel oil to MCPA in 8 gallon water per acre.

Table 5.2 Manufacturing Product Labels for MCPA

Label Number	Active Ingredient	%A.I.	Product Name	Manufacturers
264-228	MCP Acid	95%	MCPA	Amchem Products, Inc.
359-588	MCP Acid	98.5%	Rhodia MCPA Acid	Rhodia, Inc.
6305-12	MCP Acid	94%	MCPA (Technical Grade)	Robeco Chemicals, Inc.
7173-127	MCP Acid	95%	Chempar MCPA Technical Acid	Chempar Chemical Co., Inc.
7969-34	MCP Acid	85%	U-46 MCP	BASF Wyandotte Corporation
8203-18	MCP Acid	94%	MCPA Acid	Chipman Chemicals, Ltd.
9618-11	MCP Acid	95%	MCPA Acid	Trans Chemic Industries, Inc.
39335-4	MCP Acid	94%	MCPA Acid	Fallek-Lankro Corp.
359-628	MCP Dimethylamine Salt	64.1%	Rhodia MCPA Amine (5 lb. Concentrate)	Rhodia, Inc.
359-669	MCP Isooctyl Ester	96%	Rhodia MCPA Isooctyl Ester	Rhodia, Inc.
534-131	MCP Isooctyl Ester	99.0%	Technical MCP Ester	AGSCO, Inc.
9618-12	MCP Isooctyl Ester	99.9%	Technical I 0 Ester	Trans Chemic Industries, Inc.
39511-44	MCP Isooctyl Ester	97%	Transvaal MCPA Isooctyl	Vertac, Inc.
39511-43	MCP Butyl Ester	97%	Transvaal MCPA Butylester	Vertac, Inc.
11687-76	MCP Butoxyethyl Ester	97.0%	MCPA Low Volatile Oxy Ester	Transvaal, Inc.
39511-45	MCP Butoxyethyl Ester	97%	Transvaal MCPA Low Volatile Oxy Ester	Vertac, Inc.
9618-10	MCP Isopropyl Ester MCP Isobutyl Ester MCP N-Butyl Ester	47.5% 28.5% 19.0%	Mixed Technical MCP MCP Ester	Trans Chemic Industries, Inc.

volatilization (particularly esters). Typical restrictions include limits on certain formulations (usually esters), wind speed, temperature and application method. Some states (California and Oregon) require special permits for the use of phenoxy herbicides.

Environmental Fate Profile

Data on physico-chemical degradation, mobility, and accumulation are requried for MCPA acid, salts, and esters of MCPA. However, the Agency has determined that because of the interconvertability of MCPA acid and salts, MCPA and salts may be considered as one entity for testing purposes. For esters the situation is different. The Agency has no data on the rates of hydrolysis of MCPA esters in living and non-living systems, and, therefore, there is no reason to believe that MCPA acid and esters are equivalent for testing purposes. Registrants of products containing esters of MCPA acid have the option of providing all categories of data on each ester form, or of citing data showing that a particular ester would be equivalent to MCPA acid under test conditions. The Agency will accept references to valid data on analyogous chemicals (i.e., 2,4-D).

Preliminary data indicate that MCPA may not hydrolyze at pH 7, because MCPA was not lost following heating at temperatures of 34 to 35°C for 13 days. MCPA appears to photolyze, and has a photolytic half-life of 20 to 24 days in sunlight at pH 8.3. When exposed to fluorescent light, three major photolysis products (4-chloro-2-methyl-phenol, 4-chloro-2-formylphenol, and o-cresol) are formed within 71 hours at pH 9.8.

Because MCPA adsorbs to organic matter, it is degraded more rapidly in soils containing less than 10% organic matter than in soils containing higher levels of organic matter. The half-life of MCPA at pH 5.5 to 8.5 is 5 to 6 days. At pH's of 5 and below, the half-life increases and ranges from 13 to greater than 50 days.

MCPA is degraded by aquatic organisms within 13 days of application. Soil bacteria, fungi, and algae are capable of metabolizing MCPA, with MCPA being utilized as a source of carbon in many species. In general, growth and other biological functions of microorganisms are not inhibited by MCPA. However, there are data available which indicate that MCPA may inhibit nitrogen fixation in *Rhizobium* spp. and in blue-green algae.

MCPA can be expected to leach in most soil types, with the degree of leaching being inversely related to the amount of organic matter in the soil. Mobility increases as the amount of organic matter decreases, probably due to the adsorption of MCPA to soil organic matter. Because of its ability to readily leach in certain soil types, MCPA may contaminate groundwater. This would be especially true of MCPA salts, which are highly water soluble. Sampling and monitoring data from wells in Ontario, Canada indicated MCPA residues (1.1-1,000 ppb) in 2 of the 237 wells sampled.

Since MCPA is degraded less rapidly and leaches more slowly in soils high in organic matter, MCPA can be expected to dissipate at a much slower rate in these soil types. The field dissipation of MCPA may require up to 20 weeks following initial application. In the aquatic environment, however, dissipation occurs much more rapidly, typically within 32 days of application. A common metabolite of MCPA, 5-chloro-o-cresol, is formed at low levels within 1 day of application to water. Although data indicate that MCPA does not seem to persist in water, it may indeed persist in sediments. MCPA also seems to persist in leaf litter and the upper 3 cm of soil in the forest ecosystem.

Exposure Profile

The high volatility of most MCPA ester formulations increases the potential of respiratory exposure, whereas the MCPA salt formulations are essentially nonvolatile. Spray drift, primarily from aerial spraying operations using ester formulations, may lead to exposure of humans, livestock, wildlife, and crops outside of the application site. It is anticipated that the most significant direct exposure will be to workers during mixing and loading operations. Dermal and ocular exposure from splashing of the concentrates can occur during mixing of the SC/L and EC formulations. Respiratory exposure to highly volatile ester formulations may also occur. However, no data are available to assess such exposures. Dermal and ocular exposures could be minimized by the use of gloves, goggles, and other protective clothing while MCPA is being handled. Respiratory exposure during mixing could be minimized by working in well ventilated areas or wearing an appropriate respirator.

More data are necessary to fully estimate potential exposure to MCPA. These data include: bioaccumulation data and the octanol/water partition coefficient; data to quantify human exposure during handling and application operations; data showing dissipation of dislodgeable residues on plant surfaces; and volatility data which would indicate potential inhalation exposure.

Topical Discussions

Physico-Chemical Degradation

One preliminary study indicated that MCPA is resistant to hydrolysis at pH 7, because MCPA was heated to 34 to 35°C for 13 days at pH 7 without any noticeable loss (Soderquist and Crosby, 00004448 and 05003445). MCPA in 1% $NaHCO_3$ aqueous solution (pH 8.3) has a photolytic half-life of 20 to 24 days in sunlight (Soderquist and Crosby, 00004448 and 05003445). When exposed to fluorescent light (>290 um), MCPA in aqueous solution (pH 9.8) produces three minor (<10%) photolysis products: 4-chloro-2-methyl-phenol, 4-chloro-2-formylphenol and o-cresol in 71 hours.

Metabolism

MCPA is degraded more rapidly in soils containing less than 10% organic matter than in soils containing higher levels of organic matter. In soils containing less than 10% organic matter, MCPA was degraded within 1 day. In soils containing higher percentages of organic matter, degradation was slowed to between 3 and 9 days (Torstensson, 1975, 05008552). This may be due to adsorption to the soil organic matter. MCPA, when applied a second time to soil, is degraded almost twice as fast (6 to 12 days) as it is after one application (15 to 28 days). The half-life of MCPA, in a soil-inoculated salt solution, is 5 to 6 days at pH 5.5 to 8.5 but increases to 13 to >50 days at pH's of 5 and below. Preliminary evidence indicates that persistence is not influenced greatly by soil type (Loos et al., 05012194).

Unlabeled MCPA in rice paddy water under dark conditions is almost totally degraded (over 99%) by aquatic microorganisms in 13 days (Soderquist and Crosby, 00004443 and 05003445).

Several bacteria are capable of metabolizing MCPA, and degradation is more rapid if bacteria become adapted to MCPA. The proposed MCPA degradation pathway for Pseudomonas (NCIB 9340) (Gamar and Gaunt, 05005451; Gaunt and Evans, 05003416) is as follows: side-chain loss (5-chloro-o-cresol), hydroxylation (5-chloro-3-methylcatechol), ring fission (γ-chloro-α--methylmuconic acid), dehalogenation and lactone formation (γ-carboxymethylene-α-methylα-βbutenolide), and lactone splitting (γ-hydroxy α-methylmuconic acid). Other products isolated from culture fluids indicate the possiblity of minor metabolic pathways.

Arthrobacter sp. and Flavobacterium peregrinum also cleave the acetate side chain, yielding 5-chloro-o -cresol (Bollag et al., 05004641). The above bacteria, as well as Achromobacter sp., are capable of oxidizing 5-chloro-o-cresol and/or 4-chlorocatechol, a potential MCPA degradation product (Bollag et al., 05004641; Loos et al., 05003910; Steenson and Walker, 05004430 and 05013551). Pseudomonas (NCIB 9340) and Arthrobacter sp., adapted to MCPA, complete ring fission and dehalogenation of MCPA at very high concentrations (1,000 and 2,000 ppm, respectively) within 120 hours (Bollag et al. , 05004641; Gaunt and Evans, 05003416). Alcaligenes paradoxus JMP116 and a"Corynebacterium-like" bacterium also oxidize MCPA and, as with some of the above bacteria, may utilize MCPA as the sole carbon source (Fisheret al. , 05003428; Jensen and Petersen, 05003757 and 05004434; Steenson and Walker, 05015452). A transferrable plasmid, pJP1, allows A. paradoxus to utilize MCPA as a carbon source (Fisher et al., 05003428).

Several fungi (Aspergillus niger, Fusarium culmorum, Gloeosporum kaki, G. olivarum, Mucor sp., Penicillium sp., Schizophyllum commune, Verticillium spp., and Zygorhynchus moelleri) metabolize MCPA (Faulkner and Woodcock, 05003766; Nakajima et al., 05005548; Torstensson et al., 05004649). Two fungal metabolites are 4-chloro-5-hydroxy-2-methylphenoxyacetate and 2-(2-methyl-4-chlorophenoxy)ethanol.

Microorganisms, in general, are not inhibited by MCPA at recommended application rates (0.1 to 1.5 ppm). While not inhibiting growth of Rhizobium spp. or blue-green algae, MCPA at 0.1 ppm inhibits nitrogen fixation by Rhizobium spp.; and at 20 ppm, nitrogen fixation by blue-green algae (Abou Elfadl and Fahmy, 05008511; Balezina, 05012661; DaSilva et al., 05005265 and 05009423; Fletcher and Raymond, 05005788; Gillberg, 05005888; Hutber et al., 05020356; Noll and Bauer, 05020766; Torstensson, 05004429; Vintikova et al., 05003543). Soil microbial functions other than nitrogen fixation are generally not affected by MCPA at recommended rates of application, although nitrifi cation may be temporarily inhibited (De and Mukhopadhyay, 05004661; Grossbard, 05015630; Jensen and Sorensen, 05004656; Sommer, 05020404; Torstenssen, 05004188; Verona, 05019175). The growth of bacteria, fungi, and algae similarly is not inhibited by MCPA (Balezina, 05012661; Da Silva *et al.*, 05009865; De and Mukhopadhyay, 05004661; Kulinska, 05019112; Kunert, 05008678; Metting and Rayburn, 05019847; Nakajima *et al.*, 05005548; Steenson and Walker, 05015452; Torstensson, 05004188; Toure and Stenz, 05016148; Verona, 05019175; Wehr and Klein, 05015407; Wilkinson and Lucas, 05006526; Zauner *et al.*, 05021608).

Mobility

MCPA would be expected to leach in most soils. Phytotoxic levels of MCPA leached 30 cm in a sandy soil column eluted with 50 cm of water (Herzel and Schmidt, 05021236). Using soil thin-layer chromatographic techniques, MCPA was mobile (R_f-0.6-1.0) in calcium montmorillonite clay (Helling, 05016652) and in sandy loam and silty clay loam soils (Helling and Turner, 05004203). Mobility increases as the organic matter content decreases, possiblity due to the adsorption of MCPA to this soil component.

Significant volatilization of MCPA is unlikely in the environment since no MCPA volatilizes from an aqueous solution (pH 7.0) heated at 34 to 35°C for 13 days (Soderquist and Crosby, 00004448 and 05003445).

Adsorption of MCPA to soil requires further study. MCPA adsorbs to goethite (hydrated iron oxide) only at pH's below the point of zero charge (<pH 8) and adsorption increases with decreasing pH (Kavanagh *et al.*, 05005526). The role of such positively charged clay minerals in the adsorption of MCPA to natural soils in unknown.

Groundwater Contamination

Because MCPA leaches in most soils, there is a potential for contamination of groundwater (Herzel and Schmidt, 05021236; Helling, 05016652; and Helling and Turner, 05004203). MCPA residues were detected in 2 of 237 wells sampled in Ontario, Canada, between 1969 and 1978 (Frank *et al.*, 05019954). One positive sample had MCPA residue levels in the 1.1 to 10 ppb range and the other positive sample had MCPA residue levels in the 101 to 1,000 ppb range. An accidental spill of 1,000 liters of a 40% MCPA solution on soil in Czechoslovakia contaminated wells within 150 m of the spill site. The wells contained MCPA at 0.1 to 6.4 ppm for 8 to 11 months after the spill before the concentrations decreased below detectable levels (Synek *et al.*, 05009727). Although MCPA is mobile in soils and has been detected in isolated well water samples, degradation of MCPA in soil and water may reduce the potential for groundwater contamination (Bollag *et al.*, 05004641; Faulkner and Woodcock, 05003766; Fisher, Appleton, and Pemberton, 05003428; Gamar and Gaunt, 05005451; Gaunt and Evans, 05003416; Jensen, 05003757; Jensen and Petersen, 05004434; Loos *et al.*, 05003910; Nakajima, *et al.*, 05005548; Steenson and Walker, 05015452, 05004430, 05013551; Soderquist and Crosby, 00004448; Soderquist and Crosby, 05003445, ; Torstenssen *et al.*, 05004649).

Dissipation

Using bioassays, MCPA appears to dissipate within 3 to 7 weeks from soil treated with 0.75 to 1.5 ppm for 6 to 19 previous years (DeRose, 05011096; Fryer and Kirkland, 05006578; Torstensen *et al.*, 05004649). An initial application of MCPA may require up to 20 weeks for complete dissipation.

In the forest ecosystem, MCPA remains in soil (0 to 3 cm) and leaf litter at 0.7 and 32 ppm, respectively, 10 months after application at 2.5 kg ae/ha (Eronen *et al.* , 05008355). MCPA residues in moss decline to 7% of the initial level within 40 days. Residues in soil (3 to 15 cm deep) are not detectable after 40 days.

MCPA dissipates from soil at similar rates whether applied alone or in combination with dicamba and bromoxynil (Suzuki, 00004563). The time required for MCPA to dissipate to nondetectable levels from sandy and silt loam soils, alone or in combination, is 30 to 60 days.

In the aquatic environment, MCPA dissipates rapidly (14 to 32 days) in water, but residue levels in the flooded soil remain unchanged (Soderquist and Crosby, 00004448 and 05003445; Sokolov *et al.*, 05010497 and 05012269). A common metabolite, 5-chloro-*o*-cresol, is formed at low levels (1.3% or less) within 1 day of treatement. Frank *et al.*, (05019954) detected MCPA residues (1.1 to 1,000 ppb) in two of 237 wells sampled in Ontario, Canada, between 1969 and 1978.

Label Restrictions

Current label restrictions prohibit the use of MCPA-butoxyethyl ester in greenhouses, on heavy clay soils, or where crops will be planted in a rough, cloddy seed bed. MCPA-diethanolamine salt or MCPA-isooctyl ester should not be applied by air in the vicinity of sugar beets. MCPA-isooctyl ester should not be used around homes, recreation sites, or similar areas. MCPA-sodium salt should not be applied with nozzles that produce a fine spray.

CHAPTER VI

TOXICOLOGY OF MCPA

Introduction

A wide range of MCPA products are currently registered for use. Manufacturing-use products containing MCPA acid, the dimethylamine salt of MCPA, the isooctyl ester, the butyl ester, the butoxyethyl ester, or a mixture of the isobutyl, isopropyl, and butyl esters are currently available. End-use products containing the sodium salt of MCPA, the diethanolamine salt of MCPA, the dimethylamine salt of MCPA, the isooctyl ester of MCPA, the butoxyethyl ester, or a mixture of the butyl and isopropyl esters are also available.

The Agency is requiring a full battery of toxicological testing on technical grade MCPA acid to support the food uses of this active ingredient. The Agency has made a preliminary determination that acute, subchronic, and chronic toxicological testing of MCPA acid will provide sufficient information to support the requirements for testing of the technical grade esters of MCPA and each manufacturing-use MCPA salt. Registrants have the option of supplying the full battery of acute, subchronic, and chronic toxicological testing on each technical grade ester and each manufacturing-use MCPA salt or of citing data which show that a particular ester or salt will be equivalent to MCPA acid under test conditions.

Manufacturing-Use MCPA

Toxicology Profile

Acute Toxicity

Single-dose oral toxicity testing of MCPA indicates that MCPA acid has a relatively moderate acute oral toxicity in rats, with an LD_{50} value of 1.33 g/kg in male rats and .765 g/kg in female rats. No data were available with respect to the acute dermal toxicity, acute inhalation toxicity, primary dermal irritation potential or dermal sensitization potential of MCPA. Primary eye irritation testing of an end-use formulation indicates that MCPA may be a severe irritant.

Acute Delayed Neurotoxicity

Because MCPA is structurally similar to a suspected neurotoxin, 2,4-D, testing of MCPA may be required. The Agency is reserving its decision to require this testing on MCPA until testing of 2,4-D has been completed. Testing of 2,4-D is currently underway.

Subchronic Testing

Sufficient data were available to set a no-observed effect level (NOEL) for MCPA of 3 mg/kg in rats. Testing in beagle dogs indicates that MCPA may induce dose-related curtailment of spermatogenic activity, tubular atrophy, and prostatic changes, including immature and atrophic appearance. The NOEL for these effects was set at 4 mg/kg.

The Provisional Acceptable Daily Intake (PADI) of MCPA in the human diet is .002 mg/kg/day or MPI .12 mg/day based on the NOEL reported in the subchronic dog study.

Teratogenicity and Mutagenicity Testing

In teratology testing of MCPA, reported results indicated that MCPA may be teratogenic and fetotoxic. The incidence of minor skeletal variants and decreased fetal weights in mice was significantly greater at 100 mg/kg dietary levels of MCPA. The NOEL for this effect was set at 25 mg/kg. In a separate study at dietary levels of 60 and 100 mg/kg, the major malformation rate was significantly increased and fetal weights were significantly decreased. The NOEL for fetotoxicity was set at 30 mg/kg.

In mutagencity testing of MCPA, data were available which indicated that MCPA may be a weak mutagen in certain study systems. MCPA was observed to induce mutations in Saccharomyces cerevisiae and in Drosophila. MCPA has also been reported to cause inhibition of testicular DNA synthesis in male mice.

Other mutagenicity testing indicates that MCPA does not induce mutations. Thus, data are inconclusive, and additional testing is required.

Reproduction

A valid reproduction study was not available for review. However, a supplementary spermatogenesis study showed that male rats receiving as low as 13 mg/kg/day MCPA in drinking water had slight degeneration of the seminiferous tubules with loss of spermatids. It should be noted that these effects were erratic, but nonetheless similar events were demonstrated in the subchronic feeding study using dogs.

Metabolism

Metabolism data indicate that the major route of excretion is urinary elimination in rats within 192 hours of dosing. The data did not indicate MCPA bioaccumulation.

No other valid data on the toxicity of MCPA acid were available for review. Chronic feeding studies, additional reproduction studies, and oncogenicity testing are required.

Topical Discussions

Acute Oral Toxicity

Adequate acute oral toxicity testing in rats (Raltech, 19??, 00021972) is available for technical grade MCPA acid. In this study, MCPA was administered in water by means of a feeding needle to 8 male and 8 female Sprague-Dawley albino rats. The estimated oral LD_{50} in the male rat was found to be 1.383 g/kg body weight with 95% confidence limits of 1.124 to 1.716 g/kg, and in the female rat was determined to be 0.765 g/kg body weight with 95% confidence limits of 0.598 to 1.025 g/kg. Gross autopsy revealed no significant specific toxicity. Data are sufficient to satisfy Agency requirements.

No data were available on any manufacturing-use salt or ester of MCPA. Testing is required unless registrants provide suitable evidence to substantiate that particular salts and esters will be similar in toxicity to MCPA acid.

Acute Dermal Toxicity

No data were available; testing of MCPA acid is required. Testing of each manufacturing-use salt and ester of MCPA is also required unless registrants provide suitable evidence to substantiate that particular salts and esters will be similar in toxicity to MCPA acid.

Acute Inhalation Toxicity

Partial data are available for the sodium salt of MCPA that indicate that this salt is in Toxicity Category IV. Testing of all other manufacturing-use salts and esters of MCPA is also required unless registrants provide suitable evidence to substantiate that particular salts and esters will be similar in toxicity to MCPA acid.

Primary Eye Irritation

Available data on a soluble concentrate formulation containing the sodium salt of MCPA indicates that this formulation is a severe irritant to the eye. This testing places MCPA in Category I for primary eye irritation. See the topical discussion under end-use MCPA for details on this study. Registrants have the option of accepting this determination and classification for MCPA acid and each of its salts and esters, or of supplying data specific to technical grade MCPA acid and each of its salts and esters.

Primary Dermal Irritation

No data were available; testing of MCPA acid is required. Testing of each manufacturing-use salt and ester of MCPA is also required unless registrants provide suitable evidence to substantiate that particular salts and esters will be similar in toxicity to MCPA acid.

Dermal Sensitization

No data were available; testing of MCPA acid is required. Testing of each manufacturing-use salt and ester of MCPA is also required unless registrants provide suitable evidence to substantiate that particular salts and esters will be similar in toxicity to MCPA acid.

Acute Delayed Neurotoxicity

Although MCPA is not expected to cause cholinesterase depression, it is structurally related to 2,4-D which is suspected of causing neuropathy. Testing of 2,4-D is currently underway. The Agency is reserving this requirement for testing of MCPA until the results from 2,4-D testing have been submitted and evaluated.

Subchronic Oral Toxicity

The minimum data requirement for subchronic oral toxicity is one test of MCPA acid in two mammalian species, preferably the rat and dog. Testing of each manufacturing-use salt and ester of MCPA is also required unless registrants provide suitable evidence to substantiate that particular salts and esters will behave similarly under test conditions.

A subchronic oral toxicity test is required for MCPA because its uses (application to food crops) require a tolerance.

An adequate study was conducted on Charles River rats (10 animals/sex/dose) fed 0, 4, 8 and 16 mg/kg/day technical MCPA acid for 90 days (Holsing and Kundzin, 1970, 00004776).

The mean body weights, weight ranges, food consumption, and survival data of the test animals were comparable to the control values. No mortality was noted.

The hematocrit and hemoglobin determinations, erythrocyte counts, total and differential leukocyte counts, fasting blood sugar, BUN, total serum protein, total serum bilirubin, SGOT, serum alkaline phosphatase, and serum electrophoresis, recorded at 1 and 3 months from 5 rats of each sex from the control and each test group, revealed no significant differences from the control values. The serum albumin, serum sodium, serum potassium, serum chloride, carbon dioxide, serum calcium, and SGOT determinations, made at 3 months only from 5 animals of each sex from the control and each test group, revealed no significant differences between the test and control values. The urine analysis conducted at 1 and 3 months revealed no abnormalities.

Organ weights of the heart, liver, spleen, kidneys, testes with epididymis, thyroid, and adrenals revealed signficiant increases in the male kidney weight and organ to-body-weight ratio for the males at 16 mg/kg/day. Male kidney weights at the 4.0 and 8.0 mg/kg/day levels showed a moderate increase in weight.

The microscopic examination of the pituitary, thyroid, heart, liver, spleen, kidney, adrenal, stomach, pancreas, small intestine, large intestine, mesenteric lymph node, urinary bladder, testis, ovary, and bone marrow from five male and five females from the control and 16 mg/kg level, plus the liver, kidney and unusual lesions from five of each sex of the remaining test groups, revealed no histopathological alterations which could be considered as compound-related. The no-effect level for rats is 8 mg/kg/day.

An adequate study was conducted on Beagle dogs (4 animals/sex/dose) fed (0, 4, 8 and 16 mg/kg/day) technical MCPA for 13 weeks (Holsing and Kundzin, 1970; 00004757).

The appearance, behavior, and appetite, of the test animals was considered normal. The hematology data showed normal variations. No compound-related alterations were evident. The blood chemistry data revealed no significant alterations. Within these normal observations two trends were noted, one being the slight increase in BUN value at 13 weeks for males and the other an increase in the bromsulphalein retention at 13 weeks in males.

The 16 mg/kg males showed decreased testis weights and weight ratios. Other organ weights were not remarkable. Microscopic examination of tissues revealed 3 of the 4 high level dogs to exhibit curtailment of spermatogenic activity and varying degrees of tubular atrophy. Prostatic changes associated with the testicular abnormalities were immature or atrophic appearance. A similar prostatic alteration was noted in 2 of 4 animals at the 320 ppm level and 1 of 4 animals at the 160 ppm and in 1 control dog. These data show that the no-effect level for dogs is 4 mg/kg.

A supplementary study (Holsing, 1968, 00004756) was conducted on Beagle dogs (3 animals/sex/dose) fed technical MCPA for 13 weeks at the following dose levels: control, 25 mg/kg, 50 mg/kg, 100 mg/kg. There was body weight loss noted at all dosage levels.

The hematological data for low level (25 mg/kg) revealed only 1 female with gradual decrease in the hemogram at 1 month. The middle level (50 mg/kg) animals also showed lowered hemograms in addition to marked increase in band cells and slight increases in metamyelocytes. All dogs of the high dose (100 mg/kg) level showed a decrease in hemograms at the 1 month interval.

The biochemical studies showed a variety of abnormal findings throughout the test and control animals. The abnormal findings which appear compound related were elevated BUN at all dosage levels, elevated SGOT at all dosage levels and a decrease in the serum postassium. The data resulting from the 13 week dog feeding study indicate that the no-effect level is less than 25 mg/kg.

A supplementary study (Holsing and Kundzin 1968; 00004775) was conducted on Charles River rats (10 animals/sex/ dose) fed 0, 25, 50 and 100 mg/kg/day technical MCPA for 90 days Body weight gain inhibition was noted for both sexes at the 100 mg/kg level. Food consumption for this level showed a decrease as compared to the control values. The doses selected were too high to ascertain the no-effect level.

The clinical laboratory studies conducted on 5 animals of each sex from the control and test groups, at 1 and 3 months consisting of hematocrit and hemoglobin determinations, erythrocyte counts, total and differential leukocyte counts, fasting blood sugar, BUN, total serum protein, total serum bilirubin, SGPT, serum alkaline phosphatase, serum electrophoresis, plus the serum albumin, serum sodium, serum potassium, serum chlorides, carbon dioxide, serum calcium and SGOT revealed no significant differences between the test and control values.

Urine analysis conducted at 1 and 3 months and consisting of specific gravity, pH, glucose, ketones, total protein, bilirubin, and microscopic examination of the sediment showed no significant compound related differences between the test and control animals. Organ weights of the heart, liver, spleen, kidneys, thyroid, adrenals, and testis with epididymis revealed a significant decrease. Of these findings only the decreased liver weight appears to be compound-related.

The microscopic examination of the pituitary, thyroid, adrenal, heart, spleen, kidney, liver, stomach, pancreas, small intestines, large intestines, mesenteric lymph node, urinary bladder, testes, ovary and bone marrow revealed dose related cytopathologic changes in the kidney and liver. The data indicate that the no effect level in rats is less than 25 mg/kg/day.

Available data satisfy Agency requirements for testing of MCPA acid.

Other inadequate subchronic oral toxicity tests were conducted in rats and are briefly discussed below:

In an inadequate subchronic oral toxicity study (Mattula et al., 1977, 05003795), male Sprague-Dawley rats (10 or 20/dose) were given analytical grade MCPA acid in drinking water at concentrations of 100, 500, 1,000, 2,000 and 3,000 mg/liter for 9 weeks. The deficiencies in this study included observations on less than 10 rats per dosage, use of only one sex, incomplete pathological data, lack of clinical observations, and inadequate reporting of group findings. These deficiencies preclude the use of this study.

In another inadequate oral study, the toxic effects of analytical grade MCPA on spermatogenesis in young rats were investigated (Elo and Parvinen, 1976, 05004181). The use of less than 10 rats per dose, the short duration of the study, and discrepancies in recording some of the data preclude the use of this study.

Subchronic Inhalation Toxicity

The minimum data requirement for subchronic inhalation toxicity is one test on technical MCPA acid and each salt and ester, preferably using the laboratory rat. Testing of each salt and ester is required unless registrants submit evidence substantiating that the particular salt or ester will be similar in toxicity to MCPA acid.

A subchronic inhalation toxicity test is required if pesticidal use will result in repeated inhalation exposure at a concentration which is likely to be toxic as determined from the results of the acute inhalation testing and other testing. This test could be required pending the results of the acute inhalation toxicity tests of the technical chemicals. The acute inhalation testing with the acid and sodium salt 2 lb/gallon soluble concentrate/liquid places that in Toxicity Category IV indicating very mild toxic effects.

Subchronic Neurotoxicity

The minimum data requirement for subchronic neurotoxicity testing is one test on technical MCPA acid, using a mammalian species.

A subchronic neurotoxicity test may be required if the pesticide shows positive results in the acute delayed neurotoxicity test or induced irreversible neurological toxicity in a mammalian species. Testing of each salt and ester of MCPA may also be required.

A subchronic neurotoxicity test may be required if the neurotoxicity test is positive for 2,4-D (and MCPA, if tested).

Chronic Feeding

The minimum data requirement for chronic feeding is one test on technical MCPA acid, preferably using the laboratory rat. Testing of each salt and ester of MCPA is also required unless registrants provide evidence substantiating that a particular salt or ester will be toxicologically equivalent to MCPA acid.

A chronic feeding study is required if pesticidal use requires a tolerance or an exemption from a tolerance, requires the issuance of a food additive regulation, or is likely to result in repeated human exposure over a significant portion of the life span.

A chronic test is required for MCPA because its uses (application to food crops) require a tolerance.

No data were available to assess the chronic feeding of MCPA. Testing in a mammalian species is required, and since the dog is the more sensitive species, a 1-year dog study is necessary with histopathology of the gonads.

Oncogenicity

The minimum data requirement for oncogenicity is testing in two mammalian species, preferably the rat and mouse, using technical MCPA acid. Testing of each salt and ester is also required unless registrants provide evidence substantiating that a particular salt or ester will be toxicologically equivalent to MCPA acid.

An oncogenicity test is required if the active ingredient, or any of its metabolites, degradation products, or impurities is structurally related to a recognized carcinogen or causes a mutagenic effect; requires a tolerance or an exemption from a tolerance; requires the issuance of a food additive regulation; or is likely to result in repeated human exposure over a significant portion of the life span.

Oncogenicity testing is required for MCPA because its uses (application to food crops) require a tolerance.

No data were available to assess the oncogenicity of MCPA acid or its salts or esters. Testing in two mammalian species is required.

Teratogenicity

The minimum data requirement for teratogenicity is testing in two mammalian species, using technical MCPA acid. Testing of each salt and ester of MCPA is also required unless registrants submit evidence substantiating that a particular salt or ester will be toxicologically equivalent to MCPA acid.

Teratogenicity testing is required if pesticidal use requires a tolerance or an exemption from tolerance, requires the issuance of a food additive regulation, or is likely to result in significant exposure to females.

Teratogenicity testing is required for MCPA because certain uses (application to food crops) require a tolerance.

A supplementary study has been submitted in two parts on the teratology of technical grade MCPA in the rabbit (Tucker, M. L., 1978; 000041635) and Irvine, L. F. H., 1980; 000041637). The Tucker study is a range finding attempt which used an extended duration of treatment from day 1 to day 27 gestation. This study on two dose levels (100 mg/kg and 25 mg/kg) resulted in no live foetuses at the high dose and no teratology at the lower dose. In this experiment there was maternal death and toxicity from lung congestion due to improper gavage techniques in the control group as well as at both levels of MCPA.

Based on this range-finding study, Irvine dosed rabbits (15/gr) at 5, 12, 30 and 75 mg/kg technical MCPA by gavage. This protocol was appropriate to core minimal guidelines with dosing from day 6 to day 18. There was again maternal lung congestion from inappropriate gavage dosing techniques which appeared to be dose related to MCPA. The dams affected had other thoracid pathology such as fibrous adhesions to the thorax. The litters affected by teratogenicity were not correlated with the maternal pulmonary affects. The protocol indicated that each group would be randomly selected to have similar mean weight and weight distribution which was not done. The animal room temperature was to be 17°C; however, there were sharp changes in temperature which elicited sufficient animal stress (to induce changes in weight in maternal animals) at time of mating. This stress was sufficient to correlate with teratogenicity in the litters. Thus the maternal loss is not dose related nor was the number of corporal lutea, number of implantations, total of early plus late fetal deaths as the percentage of implantations and the litter weight. These parameters can, however, be stress-related.

In an adequate teratogenicity test, the commercial formulation Herbotex 750 containing 75% w/w MCPA (2-methyl-4-chlorophenoxyacetic acid) 75% purity, was given daily by gastric intubation to pregnant mice, 20 per group, from day 6 to 15 of gestation at daily doses of 5, 25, and 100 mg/kg (Palmer and Lovell, 1971, 0004447). Litter weights and mean fetal weights were significantly reduced at 100 mg/kg. The incidence of minor skeletal variants was significantly greater at 100 mg/kg than in the controls. No overt signs of maternal toxicity except decreased weight gain at 100 mg/kg compared to the control group. The no-effect level, based on the incidence of minor skeletal defects and fetal weights, was 25 mg/kg.

In an adequate teratogenicity test, the technical grade MCPEE (4-chloro-2-methylphenoxyacetic acid ethylester), 94.12% purity, was mixed with food at levels of 2, 30, 60 and 100 mg/kg and given to pregnant rats, 10 to 16 per group, from day 8 to day 15 gestation (Yasuda and Maeda, 1972; 05003566). Daily intake of MCPEE, based on food consumption, was calculated to be 2.7, 30, 60, and 100 mg/kg.

The no-effect level for the fetuses was 30 mg/kg. At 60 and 100 mg/kg, the malformation rate was significantly increased and fetal weights were significantly decreased. Cleft palate, ventricular septal defect, and kidney anomalies were the major malformations. There was no maternal toxicity except a dose related lower rate of weight gain in comparison to the controls group. The major malformations were not significantly different from controls.

Another adequate study completed in Sprague-Dawley rats (Irvine, L.F.H.,1980;000041637) using MCPA technical grade 20, 50, and 125 mg/kg resulted in minimal máternal toxicity at all doses, no effect on pregnancy incidence, no difference in maternal weight gain and no difference from controls for the mean number of corpora lutea, preimplantation losses and implantations. There was also no significant MCPA associated early or total intrauterine deaths, and no change in number of fetuses per dam. The litter weights in all MCPA treated groups were significantly different from control while the sex ratios for all MCPA groups were comparable to controls.

Minor external/visceral defects of fetuses were present in all MCPA-treated groups but the incidence of these were not significantly different from controls. These include skeletal and muscular anomalies, dilated ureters, increased renal pelvic cavitation and subcutaneous haemorrhagic areas and skeletal defects.

There were no major skeletal defects in any of the MCPA-treated groups or the negative control group.

The major visceral defects included encephalocele, craniorachischisis with anophthalmia, open eye, omphaloc, arthrogryposia, and disphragmatic hernia; but these did not occur in significant numbers.

In conclusion, the Yasuda study differs from the Irvine study in the extent of teratology occurring with MCPA in the rat but in neither study was it considered to be significant. The one mouse study by Palmer and Lovell (1971) indicates that MCPA is not a significant teratogen.

The minimum data requirement for testing in two mammalian species using MCPA acid has beeh satisfied by Yasuda and Maeda (1972) in the rat and by Palmer and Lovell (1971) in the mouse.

Reproduction

The minimum data requirement for reproduction is testing in one mammalian species, preferably the laboratory rat, using MCPA acid, and lasting for two generations. Testing of each salt and ester of MCPA is also required unless registrants provide evidence substantiating that a particular salt or ester will be toxicologically equivalent to MCPA acid.

Reproduction testing is required if pesticidal use requires a tolerance or an exemption from a tolerance, requires the issuance of a food additive regulation, or is likely to result in repeated human exposure over a significant portion of the lifespan.

In an inadequate study of the toxic effects on spermatogenesis, analytical grade MCPA was given to young male Sprague-Dawley rats in the drinking water at concentrations of 100, 500, 1,000, 2,000 and 3,000 ppm (Elo and Parvinen, 1976, 05004181). Rats receiving 100 ppm (3 mg/kg/day) had slight degeneration of the seminiferous tubules; those receiving 500 ppm (61 mg/kg/day) and 1,000 ppm (112 mg/kg/day) had mild degeneration with loss of spermatids; and the rats receiving 2,000 ppm (190 mg/kg/day) and 3,000 ppm (246 mg/kg/day) had moderate degeneration with occasional loss of spermatids and spermatocytes. The effect was erratic and some rats receiving 3,000 ppm had almost normal spermatogenesis. The study does not indicate what possible effects, if any, MCPA could have on fertility, births, or survival. The use of less than 10 rats per dose, the short duration discrepancies in recording of some data, and failure to use females precludes the use of this study.

The above data is not sufficient to satisfy the requirement for reproduction testing of MCPA acid. It should be emphasized that subchronic oral testing revealed reduced spermatogenesis and tubular atrophy in testes in both rats and dogs.

Testing is required.

Mutagenicity

The minimal data requirements for mutagenicity testing will be finalized pending formulation of Agency Guidelines.

Mutagenicity testing is required for MCPA because certain uses (application to food crops) require a tolerance.

One study was done to evaluate the ability of MCPA to induce histidine reversion in *Salmonella typhimurium* (Zetterberg, 1979, 05004970). Although the study was not sufficient to satisfy the da requirement because of incomplete protocols (i.e., use of an incomplete set tester strains, use of a single S-9 concentration for microsomal activation, and lack of confirmatory testing), the data suggest that MCPA, and 5-chlorosalicylic acid (hydroxmethyl derivative of MCPA), 3-chloro-o-cresol, 4-chloro-cresol, and 5- chloro-3-methyl-catechol were not mutagenic under the conditions of the test system.

An adequate study was done to evaluate MCPA in the above mentioned system by Lassner *et al.*, (1977, 05003531) who reports negative results using 99% pure MCPA on a set of four AMES tester strains of *Salmonella typhimurium* which were pretested for genetic marks in addition to testing one of these strains against four concentrations of S-9.

Adequate studies to evaluate the toxic and mutagenic (histidine reversion) effects of MCPA and its methyl ester in the *Saccharomyces cerevisiae* haploid strain *rad-18* were done by Zetterberg (1979, 05004970) MCPA was observed to induce mutations, but only at amounts (3-6x10 -5 M of undissociated acid) that caused 95 to 99% lethality. The results were highly variable and were affected by changes in temperature and pH. The data suggest that MCPA is a weak mutagen in this study system. Also, a relationship was reported between pH, temperature, and number of reversions. The degree of acidity of the pH and elevation of the temperature drive the activity of MCPA to induce reversion of the histidiene (i.e., mutagenicity).

Zetterberg states that the increase in hydrogen ions inside the cells to an overwhelming amount causes this mutagenicity. Zetterberg theorized that mutagenicity (histidiene reversion) in *rad-18* cells only occurs in the presence of overwhelming increased hydrogen ion overproduction from the MCPA being in an acid medium. This should be considered if other in vitro mutagenicity tests are performed. MCPA methyl ester was about 100-fold less active than MCPA. Zetterberg failed to disclose the purity of the test material he used.

An inadequate study was done to determine the percentage of X-chromosomal recessive lethals in meiotic and postmeiotic male germ cells of Drosophila that were fed MCPA (unspecified portion) at concentrations of 5 and 10 *mM* (Vogel and Chandler, 1974, 05003752). An increase in the percentage of sex-linked of recessive lethals over that of controls was observed, but the difference was barely significant (p = 0.015) at pH = 8. The results suggest that MCPA is a weak mutagen in Drosophila, but this conclusion is derived from combined data at "doses" of 5 and 10 mM. There was no dose response data in addition to other inadequacies. None of the other chemically-related herbicides tested (i.e., 2,4-D, 2,4,5-T; MCPB) caused any significant increases in lethals. MCPA was not tested at acidic pH's (6.8 or below).

An adequate study by Magnusson *et al.*, (1977, 05016939) in which Drosophila were continuously fed MCPA (94% pure) throughout their larval stages at "doses" of 250 and 500 ppm, reported no increased sex-chromosome non-disjunction, loss or exchange, *but* in contrast indicate an increase in number of recessive lethals for both 2,4-D and 2,4,5-T when compared to their own controls at a significance level (P ,0.01) when the total F_1 and F_2 data were combined.

In a review Propping *et al.*, (1973; 05009237) mentioned negative results reported by Buselmaier *et al.*, 1972, 0501655 who tested MCPA in the host mediated assay in mice given 1000 mg/kg subcutaneously against the *Salmonella typhimurium* G-46 his- and *Serratia marcescens* A-21 leu; these studies further support the notion that these "hormonal" herbicides present minor hazard in systems involving mammalian metabolism at pH's of 7.2 to 7.4.

MCPA has been reported to cause inhibition of testicular DNA synthesis following intraperitoneal injection of the chemical to male mice at a dose of 200 mg/kg (Seiler, 1979; 05003508). The study is inadequate because of failure to report the purity of the MCPA sample used.

The above information is not sufficient to satisfy the criterion of multi-test evidence required for mutagenicity. Only insufficient data has been presented in these minimal studies and additional testing is required especially in mammalian species as recommended above.

Metabolism

The minimum data requirement for metabolism is a single dose using the analytical pure grade of the active ingredient in the radioactively labeled form.

A metabolism study is required for MCPA because certain of its uses (widespread application as an herbicide on food crops) requires a chronic feeding study and oncogenicity testing.

Unlabeled MCPA, stated to be pure, was administered for a single day in the diet of a steer (5 ppm) and in the diet of two cows (2.5 and 5 ppm). The unchanged MCPA could be detected, but was not adequately quantified, in the urine of these animals (Bache et al., 1964, 05006168).

Unlabeled MCPA was administered for 28 days in the diet for beef calves so that the amount consumed was 7 or 14 mg/kg/day. One day after removal from either diet, levels of MCPA were 1.4 to 23.3 ppm in kidney tissues, 0.06 to 0.09 ppm in liver tissue, and ,0.05 ppm in muscle and fat. Calves removed from the high-dose diet for 6 days had 0.07 to 0.34 ppm in the kidney and 0.05 ppm,muscle, liver and fat. A possible metabolite, 2-Methyl-4-chlorophenol, was found occasionally in kidney tissue in trace amounts (0.05 ppm) (Bjerke and Herman, 1971a, 00004625).

Unlabeled MCPA (98.2% pure) was administered for 28 days in the diet to yearling sheep so that the amount consumed was 15 mg/kg/day. One day after removal from the diet, levels of MCPA were 0.31 to 1.7 ppm in kidney tissue, 0.05 to 0.12 ppm in liver tissue, and 0.05 in fat and muscle. 2-Methyl-4-chlorophenol was found in trace amounts (0.05 ppm) in kidney tissue (Bjerke and Herman, 1971b, 00004626).

^{14}C-acetic acid-MCPA, of unstated purity, was administered by gastric injection to Sprague-Dawley rats in a dose of 3 mg. In 24 hours, 92.3% of the radioactivity was excreted in the urine and 6.8% in the feces. Between 2 and 8 hours after injection, the highest concentrations of radioactivity were present in the blood, kidney, lung, heart, suprarenal gland, liver, thyroid, and bone marrow. Radioactivity disappeared from adipose tissue more slowly than from other tissues (Elo, 1976; 050003256).

In an adequate study (Gilbert and Hopkins, 1978, 000041634) rats rapidly absorbed and excreted ($C^{14}C$)-MCPA. Urinary excretion represented the major route of elimination accounting for 94.9 and 86.1 percent of the administered radioactivity in male and female animals, respectively, in 192 hours. Fecal elimination of radioactivity accounted for only 6% of the administered radioactivity in animals of either sex during the same period. The majority of the eliminated radioactivity (78.19%) was excreted by animals of either sex during the first 48 hours.

3.7% of the administered radioactivity was detected in the 24 hour bile from 3 bile duct cannulated rats administered 100 mg/kg. P.O. (C^{14})-MCPA, the levels in the urine and feces of these animals (20.3 and 10.5% of the administered dose). Tissue concentrations of radioactivity in the 3 male bile-cannulated rats were markedly higher than the levels of tissue radioactivity in the non-cannulated animals 24 hours after a single oral administration of (^{14}C)-MCPA.

Although the author attributes these differences to relatively poor recoveries of the radioactivity in the bile-cannulated rats (34.5%) and or relatively poor medical conditions of the bile-cannulated rats, no evidence is presented to support this hypothesis.

Three other fractions having R_f values of 0,0.8 and 0.15, (each accounting for less than 5% of the sample radioactivity) were not identified in the study. The distribution of chromatographed radioactivity was not altered by incubating the urine samples with Beta-glucuronidase compared with the levels detected in the 0-24 hours without incubation.

The tissue radioactivity levels in rats receiving multiple administrations of the herbicide (mg/kg/d, P.O. x14 d) show that bioacummulations did not occur. Female rats receiving the multiple administration of the herbicide had slightly higher tissue radioactivity levels than did the male animals.

The results of the latter experiments indicated the absorptions, distributions, and eliminations of the radioactivity were not affected by repeated adminstrations of the herbicide.

Thin layer chromatography of urine sample indicated the presence of 5 radioactive fractions. The major fractions (accounting for 7.89% of the sample radioactivity) behave in a chromatographically similar manner to MCPA (R_f=0.412). A second fractions (R_f=0.40), accounting for 13.8% of the sample radioactivity was not identified in the study.

Tissue levels of radioactivity followed a similar time course as the plasma radioactivity levels. Tissue radioactivity was seen 3 hours after the administration of 100 mg/kg/day, P.O. ^{14}C=MCPA). The level of radioactivity in most tissue (the fat, skin, and ovaries are exceptions) were very low 192 hours after dosing.

Body autography of male and female animals, 6, 24, and 48 hours after (^{14}C)-MCPA administration, yielded results that were similar.

The major route of excretion is urinary elimination (94.9% male and 86.1% female) in the rat in 192 hours and much smaller percentages by the bile and feces.

The lack of an indication of tissue bioaccumulation of the labelled MCPA or metabolites is preliminary evidence that toxic events presumably would not occur within the first few days of exposure; therefore further testing is not required.

Human Exposure

Three cases reports of human poisoning by MCPA were available (Popham and Davies, 1964, 05003770; Johnson and Koumides, 1965, 05004190; Jones et al., 1967, 005008955). A 32-year old man died as a result of drinking water which contained about 85 ml of the herbicide "Verdone" comprised of 25% MCPA. The lethal dose was approximately 440 mg/kg of MCPA (Popham and Davies, 1964). Death occurred 20 hours after admission for treatment. The blood level of MCPA was 23 mg/100 ml. In the second fatal case, (Johnson and Koumides, 1965), 65-year old man died after drinking an unverified 57 ml of "Verdone." The lethal dose of MCPA was estimated to be 250 mg/kg. Death occured 20.5 hours after the patient was found unconscious. The blood level of MCPA was 18 mg/100 ml. Stomach washings contained 250 mg/100 ml of MCPA. The third patient survived cosumption of the herbicide "Phenoxylene Triple," which contained 33% MCPA, 3.5% cresols, and other impurities.

Clinical signs of toxicity were similar in the three reports and included loss of consciousness, constricted pupils, involuntary skeletal muscle twitching, low blood pressure, excessive oral secretions and deep sighing respiration with coarse rales. Clinical laboratory tests in Jones et al. (1967) suggested that kidney damage, liver damage and gastrointestinal bleeding occurred after MCPA ingestion.

MCPA End-Use Products

1. Soluble Concentrates

Acute toxicity testing of each end-use product or substantially similar product is required for the registration of these products. A determination of substantial similarity takes into consideration both the form of the active ingredient found in a particular product as well as the types and nature of inert ingredients. For purposes of acute toxicity testing or end-use soluble concentrate products, acute tests are required on representative products containing each different type of salt and ester. Alternatively, registrants may submit evidence substantiating that the toxcity of their end-use product will be equivalent to MCPA acid.

Toxicology Profile

Soluble Concentrates Containing the Sodium Salt

Sufficient data were available to show that the 2 lb/gal SC/L MCPA sodium salt had a relatively high acute oral LD_{50} in mice (560 mg/kg) (Gurd, 1964, 00022569) Cat. III; a high acute dermal LD_{50} in rabbits (2.0 mg/kg) (Raltech, 1977, 00021973) Cat. IV; and a very high acute inhalation LC_{50} in rats (21.4 mg/liter) (Biesemiar and Angevine, 1977, 00021975) Cat. IV.

Sufficient data were available to show that the 2 lb/gal SC/L MCPA sodium salt is a severe eye irritant (Raltech 1977, 00021974) Cat. I and is a mild skin irritant (Raltech, 1977, 00021976) Cat. IV.

Soluble Concentrates Containing Dimethylamine Salt

No valid data were available to assess acute oral, acute dermal, acute inhalation, primary eye and primary dermal toxicity. Testing is required or suitable evidence must be submitted to substantiate that the toxicity of this compound will be similar to technical MCPA acid.

Soluble Concentrates Containing Diethanolamine Salt

Sufficient data were available to show that the SC/L MCPA diethanolamine salt has a relatively high acute oral LD_{50} in rats (800 + 66 mg/kg) and mice 550+3 g/kg (Gurd et al., 1964, 00022563).

No data were available to assess the acute dermal, acute inhalation, primary eye and primary dermal toxicity. Testing is required or suitable evidence must be submitted to substantiate that the toxicity of this compound will be similar to the acid.

2. Emulsifiable Concentrates

Acute toxicity testing of each end-use product or substantially similar product is required for the registration of these products. A determination of substantial similarity takes into consideration both the form of the active ingredient found in a particular product as well as the types and nature of inert ingredients found in a particular product. For purposes of acute toxicity testing of end-use emulsifiable concentrate products, acute tests are required on reprsentative products, containing each different type of salt and ester. Alternatively, registrants may submit evidence substantiating that the toxicity of their end-use product will be equivalent to MCPA acid.

Toxicology Profile

Emulsifiable Concentrates Containing Butoxyethyl Ester

Sufficient data were available to show that MCPA butoxyethyl ester is a mild eye irritant (Gabriel, 1971, 00004513).

No data were available to assess the acute oral, acute dermal, acute inhalation or primary dermal irritation toxicity. Testing is required or suitable evidence must be submitted to substantiate that the toxicity will be similar to the MCPA acid.

Emulsifiable Concentrates Containing Isooctyl Ester

No data were available to assess acute oral, acute dermal, acute inhalation, primary eye and primary dermal irritation toxicity. Testing is required or suitable evidence must be submitted to substantiate that the toxicity of this formulation will be similar to MCPA Acid.

Emulsifiable Concentrates Containing Mixture of Butyl and Isopropyl Esters

No data were available to assess the acute oral, acute dermal, acute inhalation, primary eye and primary dermal irritation toxicity. Testing is required or suitable rationale must be submitted to substantiate that the toxicity of this mixture will be similar to MPCA acid.

CHAPTER VII

RESIDUE CHEMISTRY OF MCPA

MCPA is a selective post-emergence herbicide used for the control of broad-leafed weeds in small gain crops, especially wheat and rice. A wide diversity of sites comprises the remaining uses and includes both croplands and non-crop areas.

MCPA is registered for use in the form of its sodium, diethanolamine, and dimethylamine salts, its isooctyl and butoxyethyl esters, and in a mixture of its butyl and isopropyl ester. Table 5-2 lists the individual sites registered for MCPA use.

MCPA is not registered for use in the form of its ethanolamine, triethanolamine, isopropanolamine, diisopropanolamine and triisopropanolamine salts, although these forms are sanctioned in 40 CFR 180.339 (a).

The uses of MCPA on crops are food uses, and are expected to result in residues in human food and in feed of food-producing animals.

The uses on ornamentals, rights-of-way; agricultural, commercial and industrial premises; and aquatic, forest, chaparral, nonagricultural and wasteland sites have generally been regarded as non-food (N.F.) uses; but some of these are now viewed as food (or feed) uses with a potential for contaminating food.

Residue Chemistry Profile

MCPA is readily absorbed and translocated by plants, both through the roots and leaves. It is concentrated primarily in the metabolically active portions of the plant. MCPA is extensively metabolized in plants to 2-methyl-4-chlorophenol and subsequently to breakdown products. It is likely that 2-methyl-4-chlorophenol and MCPA are readily conjugated with glucose and amino acids.

Available evidence indicates that in animals MCPA binds readily to the albumin fraction of animal serum protein and is transported to the kidneys for the renal excretion. MCPA does not appear to accumulate in muscle or fat tissue nor in the liver or in milk.

The first determinations of MCPA were made using spectrophotometric methods. Currently, most assays use some form of gas chromatography.

Data Requirements and Data Gaps

The proposed Guidelines for residue chemistry have not been published. Consequently there are no citations for guidelines corresponding to the types of residue chemistry data required to support individual registrations. In general, however, the Agency must have sufficient data to be assured that the residues of the parent material and its metabolites have been identified.

Available residue studies on small grains are weak in two respects. They are sparse, and it is not always possible to relate the residues to an adequately described and validated method. It is not always clear whether or not total residues are in fact being determined. Additional data on grains are required, with a reevaluation of the tolerance when these are received. In the meantime, monitoring of the grains is recommended.

For the ditch bank use of MCPA, tolerances or labeling restrictions are needed, to be consistent with the policy established for 2,4-D.

Topical Discussions

Uptake, Distribution, and Metabolism in Plants

When applied in water, it is believed that MCPA is liberated from its salts or esters, by dissociation or hydrolysis, in the spray, on the plant surface or even within the plant. The rates of dissociation and of hydrolysis are believed to be rapid, although there seems to have been no direct evidence for this for the MCPA esters. There is a question as to whether or not the MCPA esters do in fact hydrolyze as rapidly as believed. The residue may consist of some intact ester. Here the Agency asks the registrant to resolve this question by developing a rationale, with references to data or analogous phenoxyalkanoic acids (2,4-D for example). The residual inorganic sodium salt, amine or alcohol from these processes may linger for a time on the plant before dissipating. More importance has been given to the fate of MCPA, which like the other structurally-related phenoxy herbicides, is readily absorbed and translocated by the plant (Robertson *et al.*, 1967, 05015046).

MCPA is readily absorbed via the roots. When hydroponically grown *Agrostemma githago* plants were exposed to carboxy-labeled MCPA, the radioactivity was readily absorbed by the roots and translocated to the upper portions of the plant (Sanad, 1971, 05015695).

A study conducted in Dickursby, Finland, shows that residues of MCPA in soil will be absorbed by some species and not by others. For example, Marrow stem kale was found to contain MCPA at levels up to 0.7 ppm at 37 and 100 days after applications of 1.5 kg/ha and 7.5 kg/ha at planting time. Under these same conditions, no residues (>0.009 ppm) could be detected in barley and clover (Lallukka, 1974, 05021559).

In some species, MCPA accumulates in seeds of treated plants in sufficient quantities to disturb the growth of subsequently produced seedlings (Aberg *et al.*, 1978, 05019071).

Radiotracer studies showed that MCPA readily penetrates the plant cuticle. As the age of the leaf increased, the amount of MCPA bound in the cuticle wax increased (Kirkwood *et al.*, 1972, 05004272). Addition of a surfactant increased the movement of the MCPA into a plant cell. When young bean leaves, *Vicia faba* were treated, the MCPA was readily translocated throughout the plant but primarily to the shoot apex and other rapidly growing portions of the plant (Kirkwood *et al.*, 1969, 05015041; Mueller, 1976, 05021735).

When leaves of *Sonchus arvensis* were treated with ^{14}C-labeled MCPA, the direction and extent of translocation of radioactivity varied with plant age and stage of development. When plants were very small (largest 3 cm), translocation was primarily directed to other leaves of the developing rosette. When leaves of a large rosette were treated, (leaves 5 to 15 cm) translocation was directed primarily to the roots. There was greater accumulation in secondary than in primary roots. After the shoot started to develop, (15 to 20 cm tall) radioactivity from ^{14}C-labeled MCPA applied to rosette leaves moved both acropetally and basipetally, with the major portion moving to the roots. At this stage, movement was similar whether a rosette leaf or a leaf near the inflorescence was treated. It is reasonable to conclude that ^{14}C-labeled MCPA tends to be translocated in the direction of the metabolic sink at the time of application (Fykse, 1975, 05014496).

Some data on the metabolism of MCPA are available. Most of the studies presented employ ^{14}C-MCPA where the radioactivity is in the carbonyl carbon. As a result, little information is available on the breakdown of the phenoxy ring.

In one metabolism study (Montgomery, 1970, 00005575) ^{14}C-MCPA, as the triethanolamine salt, was applied to the foliage of wheat plants. Thirteen days later the plants were harvested. The plants were extracted with 80% ethanol and the extracts subjected to thin-layer chromatography. Most of the R_f band ^{14}C was in a very low R_f band, indicating that the components of the residue containing ^{14}C were conjugated with plant constituents. A portion of the alcohol extract was evaporated to dryness and hydrolyzed with 1 M hydrochloric acid on a steam bath for one hour. After acidification, the hydrolysate was extracted with ether and again subjected to thin-layer chromatography. Two radioactive components were found in the hydrolyzed chromatography. Two radioactive components were found in the hyrolyzed extracts. One was MCPA while the other was of lower R_f, suggesting the presence of a more polar compound.

Analysis of field samples treated at the boot stage, for the MCPA metabolite, assuming it to be an hydroxy-MCPA compound, indicates that some of it may persist in the plant up to the time of harvest. However, as with MCPA, no detectable amount of the metabolite was translocated to the grain. GLC-Mass spectrographic analysis indicates that the metabolite of MCPA in wheat is a conjugated hydroxy-MCPA which undergoes some rearrangement upon hydrolysis from plant constituents.

MCPA is degraded in plants by oxidative degradation of the acetic acid side chain with the production of a phenol metabolite (Aberg, 1978, 05019071). The acid chain may be removed at the ether linkage, resulting in 2-methyl-4-chlorophenol.

This occurs in red currants and is similar to metabolism of other phenoxy compounds. The methyl group at the two position is replaced in an -OH substitution to form 2-chlorocatechol with subsequent ring cleavage of the latter compound. MCPA can also be expected to be conjugated with glucose or amino acids which could be a detoxification mechanism (Loos, 1979, 05016100; Fykse, 1976, 05013377; Leafe, 1962, 05005795; Collins *et al.*, 1971, 05003725). The metabolism of the phenoxy herbicides in plants has been extensively studied over the years. However, data documenting the metabolism of MCPA in flax, peas, rice, pasture grasses, and clover were not submitted.

MCPA is readily taken up and translocated throughout the plant, concentrating primarily in the metabolically active portions of the plant. MCPA is extensively metabolized in plants to 2-methyl-4-chlorophenol and subsequently to breakdown products. It is likely that the 2-methyl-4-chlorophenol and MCPA are readily conjugated with glucose and amino acids. Available data satisfy Agency requirements for plant metabolism data.

Metabolism in Food-Producing Animals

When use of a pesticide on agricultural crops may result in residues in animal feeds, the Agency requires data on the fate of the pesticide in food animals. Data on metabolism of MCPA in food animals consists of four feeding trials.

In 1964, a one-cow feeding trial was conducted, in which a Jersey cow was fed a complete ration containing 50 ppm MCPA for 4 days. No MCPA residues were detected in the milk of this cow. Since this was a study done using early analytical methods, the phenolic metabolite or the presence of conjugated residues was not determined (Bache, *et al.*, 1964, 00004701).

When beef cattle, sheep, and dairy cattle were fed MCPA at increasing levels ranging from 10 to 2000 ppm in the total diet for two week intervals (Leng, *et al.*, 1970, 00004622), significant residues of MCPA (<0.05 ppm) or its phenolic metabolite (<0.05 ppm) were not detected in muscle, fat, liver, or milk samples until a dietary level of 300 ppm was reached. Continuous ingestion of 1000 ppm MCPA in the total diet of dairy cows is required to cause the consistent appearance of residues in excess of 0.05 ppm MCPA or the phenolic metabolite in milk or cream. The data also show that in general residues of the phenoxy herbicides and their phenolic metabolites do not occur in conjugated form in milk. The residues dissipate within one to three days after withdrawal of the cows from a diet containing 1000 ppm of the phenoxy acids. Residues of phenolic metabolite are not greater than residues of the parent compounds in each tissue. Residues of <0.05 ppm 2-methyl-4-chlorophenol were found only in kidney of one calf and three sheep given 500 ppm MCPA in the total diet for 28 days and slaughtered the next day. No detectable residues were found in any other tissues of cattle and sheep fed 250 or 500 ppm MCPA for 28 days and slaughtered the next day or a 7 days after withdrawal.

MCPA readily binds to the albumin fraction of animal serum protein and is readily transported to the kidneys for renal excretion (Matlib *et al.*, 1971, 05015451). When MCPB and MCPA are fed to dairy animals at low levels (5 ppm), the MCPB is partially converted to MCPA and that MCPA is quantitatively recovered in the urine (Bache, *et al.*, 1964, 00004702). In Polencova (1972, 05017929), some European workers found that the formulation and materials in the formulation affected the metabolism of MCPA in guinea pigs.

Analytical Methods

Because residue data were generated over a period of many years, different methods were used to determine residues. The earliest determinations were made using spectrophotometric methods which may or may not have detected MCPA present in conjugated form. (The latter would not have been detected unless the method included a hydrolytic step to liberate the MCPA from its conjugate).Analyses have since been made by methods utilizing some form of gas chromatography. In these methods, steps were taken to liberate the MCPA and to include it in the analysis.

Residue data were generated with one or more of the following methods:

"Procedures for determining residues of MCPA (2 methyl-4-chlorophenoxy-acetic acid) in treated crop" by Conkin (Monsanto Chemical Company, 000005552) in 1956.

"Analysis of 2,4-D residues in milk and forage" by Yip and Ney, (1966, GS-0017-109). (It was adapted to the determination of MCPA and modified with an alkaline hydrolysis step).

The procedure described by St. John in "Plant Growth Regulators and Food Additives", Vol. V., G. Zweig, editor, (Academic Press, New York) 1967; 000004724. (A version of this method later appeared as Rhodia Analytical Method No. 104 and modified as Rhodia Analytical Method No. 122, described by Guardigli. (00004766 and 00021920).)

The procedure of St. John has been validated and found to give good recoveries of the MCPA and 2-methyl-4-chlorophenol on grass crops. Fresh crop material is extracted with an acidified solution of acetone. An aliquot is taken for analysis and the organic interfering medium is partitioned into diethyl ether from a dilute solution of strong base. Then the aqueous solution is acidified, the MCPA is removed with diethyl ether, the solvent is evaporated, and the residue is nitrated in a hot phosphoric acid solution. The methyl ester is formed by subjecting the reside to BF_3 methanol solution and partitioning the ester into hexane for subsequent injection into a gas partitioning the ester into hexane for subsequent injection into a gas chromatographic column. This method has been validated for barley straw and grain.

MCPA recoveries were 82.6% and 72.4% at the fortification levels of 0.05 and 0.50 ppm in barley grain and 78.3% and 69.6% at the fortification levels of 0.2 to 1.00 ppm in barley straw (Higham, 1975, 00004633). MCPA recoveries ranged from 77.1% to 76.6% and 85.7% at fortification levels of 0.10 to 0.50 ppm in wheat straw (Higham, 1974, 00004632). The method is applicable to grasses, with spike recoveries ranging from 72 to 100% (average, 87%) and a sensitivity of 0.1 ppm (St. John, 1967, 00004724).

The procedure has been modified and expanded to determine both the free and conjugated forms of MCPA and 2-methyl-4-chlorophenol (Montogomery, M.L., 1970, 00005575). The need for hydrolysis, in order to recover total residues, is demonstrated by comparison of the described method with a previously published method which does not include hydrolysis (Crow, P.N., 1974, 05003765). Recovery of MCPA spikes from wheat grain are greater than 89% at 0.05 ppm.

These MCPA extraction procedures including a base hydrolysis step and slightly modified or varied clean-up procedures have been used to determine total MCPA, 2-methyl-4-chlorophenol residues in flax (Guyton, 1977, 00004822), range and pasture grasses (Guardigli, 1973, 00021920) and peas (00004287). In flax, the rigorous extraction and clean-up procedures along with the determinative steps employed should confer adequate specificity for detection of MCPA in flax foliage, straw, and seed. Hydrolysis of conjugates by cold alkali treatment probably liberates all conjugates, but this has not been demonstrated (Guyton, C.C., 1977, 00004822).

Guardigli (1973, 00021920), subjected grasses to acid or alkaline hydrolysis and exhaustive solvent extraction. Additional residues were not recovered after exhaustive Soxhlet extraction. After clean-up on acid alumina, MCPA is nitrated and methylated before determination by gas chromatography using electron capture detection. The 2-methyl-4-chlorophenol is estimated after thin-layer chromatography via color development of spots. A detection limit of 0.05 ppm is found for MCPA and the metabolite is detected down to 0.1 ppm. Recoveries for both compound are greater than 80%. When pea vines were subjected to alkaline hydrolysis prior to organic solvent extraction, detection limits of about 0.04 ppm an 0.1 were obtained for MCPA (Guardigli, 1974, 00004787).

A method for the determination of residues in animal tissues is described by Herman (1971; 00004627). The MCPA and 2-methyl-4-chlorophenol are extracted from the tissues (muscle, liver,kidney and fat) with ammoniacal methanol. The extract is concentrated, diluted with water, acidified with phosphoric acid and partitioned into diethyl ether. The two components are separated by liquid chromatography on an acidic alumina column. The phenol is determined as free phenol and the MCPA as its methyl ester by gas chromatography, using a microcoulometric detector. When muscle and liver were fortified at levels of 0.05 to 2 ppm with MCPA and 2-methyl-4-chlorophenol, kidney at 0.05 to 10 ppm and fat at 0.05 to 0.50 ppm, average recoveries ranged from 75 to 91%. This procedure was verified by Bjerke _et_ _al_., 1971 and Bjerke, 1971 (00004625 and 00004626), using cattle and sheep tissues. The method will determine MCPA and 2-methyl-4-chlorophenol at levels as low as 0.05 ppm.

Addition of a hydrolysis step in the extraction procedure for animal tissues (Jensen, 1973, 00004439) did not result in increased residue levels. Residues of MCPA found by alkaline hydrolysis were very similar to those found without hydrolysis for samples of muscle, fat, liver, and kidney of cattle fed 500 ppm MCPA. Recoveries of 77 to 85% for MCPA and 91 to 93% for 2-methyl-4-chlorophenol added to liver and kidney indicate acceptable recoveries by the alkaline hydrolysis method.

An analytical method for determination of MCPA and 2-methyl-4-chlorophenol in milk and cream is described by Herman, _et_ _al_., 1970, (00004492). Milk and cream samples are heated with phosphoric acid followed by extraction of MCPA and 2-methyl-4-chlorophenol from milk with diethyl ether and from cream with hexane followed by diethyl ether. The cream extracts are partitioned with sodium hydroxide and the basic solutions acidified with phosphoric acid followed by extraction with diethyl ether. Cleanup of the samples is accomplished by liquid chromatograpny on an acidic alumina column. The ether eluate, containing the 2-methyl-4-chlorophenol is chromatographed directly.

MCPA is eluted from the column with bicarbonate solution, acidified, extracted into ether, esterified with diazomethane, and determined as the methyl ester by gas chromatography.

When milk and cream samples were fortified with MCPA and 2-methyl-4-chlorophenol over the range of 0.05 to 1.0 ppm, recoveries of MCPA and 2-methyl-4-chlorophenol from milk averaged 103 + 23% and 85 + 17% respectively; while recoveries from cream averaged 89 + 23% and 83 + 20%, respectively, within 95% confidence limits for individual determinations. This procedure was reverified by Bjerke et al., (1972; 05003259) in a study where dairy cattle were fed MCPA and residue levels in the milk and cream were determined. The method will detect MCPA and 2-methyl-4-chlorophenol at levels as low as 0.05 ppm.

Modification of the above milk method (See Herman et al., 1970, 00004492) to include alkaline hydrolysis (determination of free plus conjugated residues of MCPA plus metabolite) is outlined by Miller et al., (1975; 00004438). The method is sensitive to 0.02 ppm of both compounds with average recoveries ranging from 62 to 98% for MCPA and 60 to 92% for 2-methyl-4-chlorophenol. When milk samples from cows fed MCPA at a level of 1000 ppm were examined, (Miller et al., 1973, 00004433) the levels of MCPA and its phenolic metabolite were found to be the same with the alkaline hydrolysis method as those found using an acid hydrolysis.

The general methods for chlorophenoxy acids (including MCPA) in both fatty and non-fatty foods, described in the Pesticide Analytical Manual, Volume 1, Section 221, 222, 421, and 422 are recommended for enforcement purposes (See citation under "2-methyl-4-chlorophenoxy acetic acid in Pesticide Analytical Manual, Volume II), provided these are modified with an alkaline hydrolysis step to ensure recovery and measurement of conjugated residues. These methods will not determine the metabolite, 2-methyl-4-chlorophenol. If necessary, Dow methods ACR 70.17 (for milk and cream) and 71.10/71.10S (for animal tissues) may be used. The latter was tested and validated in the Agency's laboratories at 0.05 and 0.10 ppm MCPA and metabolite, but not without modifications. Owing to the necessity for modifications, there is some question of the validity of the residue data. Monitoring of residues in meat and milk is therefore recommended.

Residues in Plants

No data are available on the presence or absence of residual inorganic salt, amine, alcohol or intact esters on plants following the application of MPA in the form of its sodium or amine salts or of its esters. Their clearance will require data on the amount present or must continue to rest solely on their toxicology. With respect to the intact ester, the Agency requests the registrant to estimate its amount if present (with references to data) involving analogous chemicals, and the ability of the analytical methodology to account for MCPA ester (if present). In this connection it should be noted that according to the EPA Index, MCPA is registered for use in the form of its sodium, diethanolamine and dimethylamine salts and its isooctyl and butoxyethyl esters. According to 40 CFR 180.339 (a), the use of MCPA in the form of its ethanolamine, diisopropanolamine and triisopropanolamine salts is sanctioned. In addition, the Product Chemistry Chapter for this Standard indicated that the isopropyl, isobutyl and butyl esters are also being used—based upon available confidential statements of formula. It should therefore be expected that MCPA is being used in all of these forms.

The question of nitrosamine contamination is raised in the Product Chemistry Chapter of this Standard. Before the Agency can assess the presence of absence of residues of nitrosamine on plants the Agency will need data on the amounts of nitrosamine contamination in those formulations containing MCPA in the form of its amine salts, in particular for the secondary and tertiary alkanolamines.

The residue data evaluated in the following sections pertain to MCPA, its metabolite, 2-methyl-4-chlorophenol and their conjugates, obtained primarily through the use of the sodium and dimethylamine salts and the isooctyl ester.

Barley:

Grab samples from Colorado, Minnesota, Montana, and the Canadian provinces of Alberta and Ontario indicate that an application of MCPA, dimethylamine salt (when known) at rates of 0.25 to 0.75 lb. a.e./acre in combination with Avenge and bromoxynil results in no detectable residues (<0.05 ppm) in grain, and (<0.20 ppm) in straw of what must be presumed to be free MCPA. The intervals from treatment to harvest were (when available) 69 to 81 days. A method of the American Cyanamid Company utilizing GLC, poorly described, or not described at all, was used. Some validation data are available (Highman et al., 1975, 00005567; 00004613; and 00004611; American Cyanamid Company, 1973, 00004741 and 1974, 00004609).

These few data and the absence of a good description of the analytical method provide poor support for the established tolerance. However, conclusions drawn from residues data on the grain, forage and straw of other small grains are considered applicable to barley.

Flax

The results of two field studies to determine residues in flaxseed were presented by Monsanto Chemical Company (1956, 00004473) and Rhodia, Inc. (Guardigli, 1970; 00004766). The test plots were located in the important flax growing states of Minnesota and North Dakota and in Canada.

In the first study, concluded in 1956, flax was treated at the pre-bud stage, or at 7 weeks before harvest, at 0.25 was used to determine residues of MCPA in the "flax", but blank values, which are usually 0.2 ppm. are higher than expected for the level of residues being measured. The reported net residues of 0.1 ppm cannot be relied upon. The study, therefore, is of questionable value for tolerance reassessment.

In the second study, the dimethylamine salt of MCPA was applied at a rate of 1 lb a.e./acre. when the flax was 3 to 4 and 5 inches high (i.e. 90 or 73 days before harvest). Flaxseed and "meat/oil" from plots treated in accordance with the recommended use but at an exaggerated application rate (of 1.3X) were found to contain no detectable residues (<0.04 ppm) in seed and (<0.1 ppm) in extracted (seed) meat/oil. These determinations were made by Analytical Method No. 104 of Rhodia, Inc. (previously described under Analytical methods) which does not liberate bound MCPA. Therefore bound MCPA would have escaped detection.

The data in these two studies do not adequately support the contention that the use of MCPA will not result in detectable residues in flax. However, the evidence accumulated in the Standard indicates that MCPA is not translocated to the seeds of crops, and that there is no reasonable expectation of residues of MCPA in any form in flaxseed.

There are no data for the flax straw which may be fed to livestock. In this case, it is reasonable to expect that residues in flax straw will resemble those in the straws of the small grains.

Grasses, Pasture and Rangeland

A variety of range grasses growing in locations representing a cross-section of the country were treated with a single application of the sodium salt of MCPA at a rate of 1.5 lb. a.e./A.

The method described by Guardigli et al., (1973; 00004449) was used to determine total residues of MCPA and 2-methyl-4-chlorophenol as separate entities.

Forage samples were collected at various periods after treatment and the residues determined (Table 7-1). The maximum for residues of MCPA was 206.4 ppm at 1 day after treatment, with an average value of about 75 ppm. An initial deposit of 220 ppm on forage grasses is estimated. The residue remaining on pasture and range grass after 7 days (the specified waiting period for dairy cattle) is 28.7 ppm. Samples of grass hay (fresh/green and dried) were taken for analysis at 21 to 22 days after treatment. Maxima for residues of MCPA were 7.90 ppm in the fresh and 13.10 ppm in the dried hay.

Inasmuch as the rate for application is somewhat higher (i.e. 2 lbs a.e./A) for the dimethylamine salt, an adjustment for the difference indicates maxima of $\frac{2.0}{1.5} \times 220 = 292$ ppm on day zero and $\frac{2.0}{1.5} \times 28.7 = 38$ ppm at 7 days in pasture and range grass, and $\frac{2.0}{1.5} \times 13.1 = 18$ ppm in grass hay at the higher rate.

TABLE 7-1. SUMMARY TABLE OF RESIDUES IN/ON PASTURE AND RANGELAND GRASSES

(SODIUM SALT OF MCPA, RATE: 1.5 lbs a.i./Acre)

(00004449)

Post Treatment Period (Days)

	0-3			6-9			13-16			21-22			21-22		
Grass Species	Actual days	Phenol ppm	MCPA ppm	Actual days	Phenol ppm	MCPA ppm	Actual days	Phenol ppm	MCPA ppm	Actual days	Phenol ppm	MCPA ppm	Actual days	Phenol ppm	MCPA ppm
		Forage			Forage			Forage			Green/Fresh Hay			Dried Hay	
Johnsongrass	(1)	<0.1	93.10												
	(3)	~0.8	39.16				(14)	~0.6	14.64	(21)	~0.4	7.14	(21)	~0.4	12.06
Bermuda	(1)	~0.4	111.84	(7)	~1.6	28.68	(14)	~0.8	12.54	(21)	~0.4	6.53	(21)	<0.1	11.37
Sudan Grass	(2)	~0.4	163.44	(9)	~1.2	34.34	(14)	~0.8	4.97	(21)	<0.1	0.12	(21)	~0.1	0.18
Bermuda	(0)	~0.1	103.44										(21)	-	
	(2)	~1.6	59.55	(9)	~1.6	18.60	(14)	~2.0	5.59	(21)	~0.3	6.82	(21)	-	13.10
Bluegrass Fescue	(1)	<0.1	42.00	(7)	~0.2	18.66	(14)	-	1.49	(21)	~0.4	2.82			
Bahia Grass	(0)	<0.1	110.40												
	(3)	~1.0	52.65				(14)	~0.9	28.95	(21)	~0.2	1.28	(21)	~0.2	2.63
Bluegrass	(1)	-	7.68	(7)	-	3.24	(15)	-	0.45	(21)	-	0.35			
	(3)	-	4.05												
Bermuda	(1)	<0.1	42.00												
	(3)	~0.8	24.24				(14)	~0.4	9.72	(21)	~0.2	1.84	(21)	~0.2	4.00
Bluegrass, Foxtail Fescue	(1)	<0.1	39.60	(7)	-	8.76	(14)	~0.4	5.80	(21)	-	4.09	(21)	<0.1	9.22
Timothy Grass	(1)	~0.2	95.40	(6)	~0.8	38.16	(13)	~0.8	6.48	(21)	~0.2	3.55	(21)	~0.4	4.78
Rye, Foxtail Chest, Bromegrass	(1)	~0.4	49.68	(6)	~2.0	14.28	(13)	~1.2	6.12	(21)	-	2.76	(21)	~2.0	3.10
Bluegrass, Fescue	(1)	<0.1	206.40												
Bentgrass	(3)	~0.4	14.28	(7)	~1.2	4.08	(14)	-	0.95	(22)	~0.6	0.10	(22)	-	0.12
Fescue	(0)	-	71.40												
	(3)	-	34.68	(7)	-	28.32				(21)	-	7.90	(21)	-	12.24
Orchard Grass	(0)	<0.1	73.20												
Bentgrass	(3)	~0.4	21.84	(7)	~0.9	19.68				(21)	~0.3	1.57	(21)	~0.4	3.37
Johnsongrass	(1)	~0.2	55.20	(9)	~1.0	-	(16)	~0.15	1.10						

The metabolite, 2-methyl-4-chlorophenol was detectable even up to harvest in dried hay at 21 days after treatment. A maximum of about 2.0 ppm was observed in forage at 6 days after the high residue levels in the grasses.

The levels of residues are consistent with those of the established tolerances.

Oats:

A single grab sample of oats from Minnesota indicates that an application at 0.25 lb/acre of MCPA (used in combination with dicamba) will not result in detectable residues (<0.05 ppm) of what must be presumed to be free MCPA in oat grain and straw. The interval from treatment to harvest was 82 days. A method of the Velsicol Chemical Corporation utilizing GLC, not otherwise described, but having adequate recovery with grain, was used (Rydrych et al., 1971, 00023687).

These few data and the absence of a decription of the analytical method provide poor support for the established tolerance. However, conclusions drawn from residue data on the grain, forage and straw of other small grains are considered applicable to oats.

Rice

Results of field tests conducted from 1969 to 1971 are summarized by Devine, 1970, 00004764; Leng et al., 1970, 00004765; and Rhodia Incorporated, 1971, 00004594).

In a 1969 study (Leng et al., 1970, 00004765), rice was treated at two stages of growth with an unspecified formulation of MCPA at rates of 1 to 3 lb a.e. MCPA per acre in California. No residues of MCPA were detected (<0.02 ppm) in any samples of the grain, rice mill (by-product), hulls, 'rice polish' and bran from treatments made 106, 103 and 78 days previously. No residues were detectable (<0.05 ppm) in rice straw at 106 days, but up to 0.75 ppm were found at 78 days. The method is presumed to be that described and used by Winterlin for wheat. No attempt was made to measure the conjugated MCPA.

Rice bran and rice straw treated two times during the 1970 growing season with MCPA at a rate of 1.5 lbs a.e./acre in Arkansas, Texas and Louisiana were found to contain no free MCPA residues (<0.05 ppm) or MCPA which could be liberated with acid hydrolysis, using the method of Yip and Ney (1966; GS 0017-109).

Residues of MCPA were were found in straw harvested in California at levels ranging from <0.05 ppm to 0.14 ppm (Devine, 1970, 00004764).

When MCPA was aerially applied, at a rate of 0.5 lb a.i./A to growing stubble rice, no residue of MCPA was found on rice grain ans straw at harvest time (Rhodia, Incorporated, 1971; 00004594). Since no analytical details were given, it is assumed that the free MCPA alone was determined.

The dissipation of MCPA in a California rice field treated at a rate of 0.4 oz a.i./acre was investigated by Soderquist, et al., (1975, 05003445). Samples of water, rice plants and mud were collected at intervals for 20 days and analyzed from MCPA by established methods for plants, mud and water. Water residues declined to less than 0.01 ppm of MCPA within 14 days after application; plant residues declined from 20 ppm to 1 ppm within 20 days; mud residues remained constant at about 0.1 ppm. Photolysis of dilute aqueous MCPA solutions with either sunlight or an indoor photoreactor yields 2-methyl-4-chlorophenol as the major product; o-cresol and 4-chloro-2-formylphenol also were identified. While photosensitization was observed in water taken from the rice field, all environmental compartments except air contained measurable amounts (<0.01 ppm) at some time, but water contained the bulk of the applied MCPA whose eventual disappearance was shown to be due to biological and chemical degradation and not dilution.

The one limitation in this study is the use of a relatively insensitive flame ionization detector in the GLC analysis (with a method sensitivity of 10 ppb). Many plant species (i.e., tobacco, tomatoes, cotton, etc.) are sensitive to phenoxy herbicides in irrigation water at levels as low as 0.1 ppb. Thus the discharge to the relatively water soluble MCPA into the irrigation canal may result in crop injury by reuse of irrigation water.

Based on grab sample data (1969-1971) from numerous locations, the use of MCPA in normal rice production does not result in detectable residues of MCPA in edible rough rice grain. Low levels (<0.70 ppm) of MCPA may be found in straw which may be used for livestock feed.

The levels of residues are consistent with those of the established tolerances.

Rye:

Residue data are not available for rye grain, forage and straw. However the conclusions drawn from residue data on the grain, forage and straw of other small grains are considered to be applicable to rye. This same correlation was possible for the grain and forage of barley, oats, rye, and wheat, though not necessarily at the same level of tolerance, for 2,4-D in 40 CFR 180.142?.

Sorghum:

In studies reported by the Interregional Research Project No. 4, (1974; 00004493) a single postemergence application was made to sorghum in the preboot stage. The test locations were in Nebraska and Texas, which are important producers of sorghum.

MCPA was applied in the form of its sodium and dimethylamine salts at rates of 0.5 and 2.0 lb a.e./A; and in the form of its isooctyl ester at rates of 0.75 and 1.5 lb a.e./A. The sodium salt alone is registered for use on sorghum.

Rhodia Analytical Method #122 was used to determine total residues of MCPA and 2-methyl-4-chlorophenol as separate entities.

Samples harvested at 57 days after application of the sodium salt at 0.5 and 2.0 lbs a.e./A show total residues of MCPA ranging from 0.17 to 0.83 ppm and from 1.16 to 4.07 ppm in fodder. None (i.e. <0.04 ppm) was found in grain at the higher rate.

Residues of 2-methyl-4-chlorophenol (i.e. <0.1 ppm) were found in neither fodder nor grain at the higher rate.

Residues of total MCPA, adjusted for the difference in rates (2.0/0.75 = 2.67x) would not exceed about 1.5 ppm in the fodder.

The data remaining from the trials on the dimethylamine salt and the isooctyl ester support these findings.

There are no residue data on the forage. However, data on the grain forages can be utilized for this purpose and show residue values of up to 16 ppm after 7 days, from the application of 2 lbs a.e./A made up to the boot stage. Adjusting as before for the difference in rates, residues of total MCPA would not exceed about 6 ppm.

Levels of residues are consistent with those of the existing tolerances.

Seed and Pod Vegetables

The existing tolerance for residues in seed and pod vegetables is an extension of a negligible residue tolerance previously established for peas alone.

The data submitted reflect tests conducted during the period from 1956 to 1974. The earliest residue determinations were made using colorimetric methods described by Marquardt and Luce (in J. Agr. Food Chem. 3, 51; 1955) and by Conkin (1956, 00005552). The first method is considered too insensitive to yield reliable results at the 0.1 ppm level of the tolerance (cf: blanks ranging from <0.1 ppm to 0.6 ppm); and data from the Del Monte trials 1, 2 and 3 (described in Del Monte, 1968; 00044403) were eliminated for this reason.

After 1965, determinations were made by means of GLC, with greater sensitivities of the order of 0.01 to 0.02 ppm. One of these methods (that of Chow et al., (1965, 05003765) utilizes alkali to liberate the conjugated MCPA and thus determines the total residues of MCPA (See Del Monte, 1973, 00004444).

The data of the Summary Table (7-2) indicate that even under exaggerated rates (up to 2X) and timing (up to 14 days before harvest), there are no residues of MCPA in excess of 0.1 ppm, and probably much less than this level, in peas.

Winterlin et al., (1974, 00004453) and Bendixen (1974, 00004454) reported the results of postemergence shielded spray applications made in 1974 to beans grown in California. MCPA was applied in the form of its dimethylamine salt at from 1 to 2 lbs a.e./acre, at 110 days before harvest.

The method of Chow et al., (1965, 005003765) with modifications was used to determine total residues of MCPA in dried lima beans, small white beans and garbanzos. No MCPA (i.e. <0.01 ppm to <0.02 ppm) was detected in any of these samples.

Supportive data from Minnesota furnished by Guardigli (1974, 000004788) from applications to peas of MCPA in the form of its sodium salt at 1 lb a.e./acre, not later than the three-nodes stage before pea flowering, indicate no residues (<0.04 ppm of MCPB, and <0/04 ppm of MCPA, and <0.01 ppm of the metabolite2-methyl-4-chlorophenol. The method of application, aerial versus ground application, did not affect the residue levels.

The levels of residues in peas and beans (i.e., seed and pod vegetables) and in peavines as well, are consistent with those of the established tolerances.

Wheat

Wheat from test plots in North Dakota and two separate plots in Oregon which has been treated with MCPA, isooctyl ester (one is the boot stage and the other in the tiller stage) at rates of 0.5, and 2 lbs a.e. per acre were analyzed for total MCPA residues.

The method used was based on that of Yip and Ney (1966; GS 0017-109) and indicates an alkaline hydrolysis as described in the section on analytical methods.

Residues could not be detected by this method in samples of wheat grain sampled at harvest.

Montgomery M.L. (1970, 000005575) reported significant residues in wheat straw especially following treatments at the tiller stage. Following applications at this stage, residues at zero-day were 36 ppm, 121 ppm and 403.6 ppm for the three rates. At harvest (56th day) residues of MCPA could no longer be detected (<0.05 ppm) after corrections for recovery and background.

Grab samples of spring and winter wheat from locations in Minnesota, Oregon, South Dakota and Washington indicate that an application of 0.25 lb/acre of MCPA (used in combination with dicamba, 5-OH dicamba and bromoxynil) will not result in detectable residues of what is presumed to be free MCPA (<0.05 ppm) in green wheat, grain or straw. The shortest interval from treatment to harvest was 31 days for green winter wheat. A method of the Velsicol Chemical Corporation utilizing GLC (not otherwise described) was used with a recovery of 80% at 0.1 ppm added MCPA (Rydrych et al., 1971, 000023687).

Field samples from Oregon indicate that an application of 0.5 lb/acre of MCPA (used in combination with Avenge^{R}, bromoxynil and 2,4-D at various rates up to 0.75 lb/acre) will not result in detectable residues (<0.05 ppm) of what is presumed to be free MCPA in wheat grain. The application was made when the wheat was 6 to 8 inches high and after it had tillered; the interval being 117 days to harvest. Residues were determined by the American Cyanamid Company, with a method (see Company report C-575) utilizing a gas chromatograph equipped with a Coulson electrolytic conductivity detector operating in the halogen mode. The method was validated for residues in wheat grain; the sensitivity is 0.05 ppm (Higham et al., 1974, 000005570).

Table 7-2. SUMMARY TABLE OF MCPA ANALYSES CONDUCTED ON PEA SAMPLES

File No	CROP	YEAR	LOCATION	MCPA TREATMENT RATE	MCPA RESIDUES	MCPA FORM
Monsanto Company 00004773 and 00004441	Peas	1956	Idaho	0.25 lb a.e./acre	peas <0.1 ppm	Not identified
	Peas	1956	Wisconsin	0.25 lb a.e./acre	peas <0.1 ppm	
	Peas	1956	Wisconsin	0.50 lb a.e./acre	peas <0.1 ppm	
Del Monte Corporation 00004442 and 00004443	Peas	1968	Utah	0.33 lb a.e./acre	peas (shelled) <0.01 ppm vines <0.01 ppm @ 37 days	Sodium Salt
00004443	Peas	1972	Utah	0.25 lb a.e./acre	peas (shelled) <0.02 ppm (30 days) vines <0.02 ppm (16 days)	Sodium Salt
	Peas	1972	Utah	0.50 lb a.e./acre	peas (shelled) <0.02 ppm (30 days) vines <0.02 ppm (16 days)	
Del Monte Corporation 00004444	Peas	1973	Jtah	0.38 lb a.e./acre	peas 0.010-0.013 ppm vines 0.014-0.020 ppm	Sodium Salt
	Peas	1973	Utah	0.75 lb a.e./acre when peas are 6-inches tall	peas 0.013-0.020 ppm vines 0.016-0.028 ppm relative to checks of 0.011-0.015 ppm (peas) and 0.015-0.022 ppm (vines)	

These and other studies are listed in the Summary Table of Residues in/on Wheat (Table 7-3).

The residue levels are consistent with the levels of the established tolerances.

Grain fractions:

Because little, if any residue has been shown to be present in the grain portion (apart from the forage and straw) of the small grains, there is little or no expectation of residues in grain fractions, and therefore, no need to establish food additive tolerances for residues in grain fractions of barley, oats, rice, rye and wheat. The data on rice grain fractions (byproducts) confirms this.

Small grain - legume mixture

MCPA has been registered for use on barley - legume mixtures, oat - legume mixtures, rye-legume mixtures, wheat - legume mixtures, small grain - legume mixtures and flax - legume mixtures, but there is as yet no tolerance for residues which result in the legumes from this use. Such a tolerance has been proposed in Pesticide Petition No. 6E 1856, which is still pending.

Residues in Food-Producing Animals

When use of a pesticide on agricultural crops results in residues in animal feed, the Agency requires data on whether or not residues are transferred to meat, milk, poultry and eggs.

In a beef calf feeding study (Bjerke et al., 1971, 00004625) twelve yearling calves were subdivided into four groups of three calves each and fed a diet containing 0,250, 500 and 500 ppm of MCPA for 28 days. Average feed consumption during the feeding period ranged from 194 to 291 kg per animal with no apparent relationship to the presence of MCPA in the diet. Ingestion rates for MCPA averaged 7.1 mg/kg/day for the groups on the 250 ppm diet, and 14.4 to 14.5 mg/kg/day for the two groups on the 500 ppm diet. Feeding resulted in residues of MCPA which varied among samples of each of four tissues at the two feeding levels. Some variation is due to the fact that at the higher feeding level one group was sacrificed 6 days after the last feeding, during which time, residues will have diminished. Residues of MCPA and 2-methyl-4-chlorophenol were determined in the four tissues, muscle, liver, kidney and fat by a validated analytical method (Dow ACR 71-10), with a claimed lower limit for sensitivity of 0.05 ppm for both components of the residue.

Significant residues were found in liver and especially in kidney at both feeding rates. Withdrawal for 6 days resulted in a substantial reduction of residues in these tissues (see Summary Table of Residues in Tissues of Calves (Table 7-4)).

In a supplement to this study, Jensen et al., 1973 (00004439), incorporated an alkaline hydrolysis step in the analytical procedure, but could not liberate any additional residues of MCPA and of the metabolite, 2-methyl-4-chloro-

TABLE 7-1

SUMMARY TABLE OF RESIDUES IN/ON WHEAT

REFERENCE	CROP	YEAR	LOCATION	HERBICIDES APPLIED	MCPA RESIDUES* AT HARVEST	OTHER RESIDUES	MCPA FORM
State Institute of Agri. Chem., Finland 05019284	Wheat	1976	Finland	MCPA (0.25 kg a.e./ha)+ cyanazine, dichlorprop	<0.01 ppm	MCPA did not result in detectable cyanazine or dichlorprop residues	Not given
Rydrych,D. *et al.* 00023687	Wheat	1971	Rosemount,MN Brookings,SD	MCPA (0.25 lb a.e./A)+ Banvel (0.25 lbs/A)	<0.05 ppm (grain & straw)	<0.01 ppm Banvel	Not given
Rydrych,D. *et al.* 00023687	Oats	1971	Minnesota (Grab sample)	MCPA (0.82 lbs a.e./A)+ Banvel (0.25 lbs/A)	<0.05 ppm	<0.01 ppm Banvel	Not given
Rydrych,D. *et al.* 00023687	Wheat	1970	Oregon	MCPA (0.25 lbs a.e./A)+ Banvel (0.125 lbs/A)+ Bromoxynil (0.25 lbs/A)	<0.05 ppm	<0.01 ppm Banvel	Not given
Rydrych,D. *et al.* 00023687	Wheat	1970	Washington	MCPA (0.25 lbs a.e./A)+ Banvel (0.125 lbs/A)+ Bromoxynil (0.25 lbs/A)	<0.05 ppm	<0.01 ppm Banvel	Not given
Higham,J.W. *et al.* 00005570	Wheat	1974	Oregon	MCPA (0.50 lbs a.e./A)+ Avenge (0.75 lbs/A)+ Bromoxynil (0.5 lbs/A)	<0.05 ppm	<0.05 ppm Bromoxynil	Not given
Higham,J.W. *et al.* 00004690	Wheat	1976	Montana	MCPA (0.37 lbs a.e./A)+ Avenge ((0.75 lbs/A)	<0.05 ppm grain <0.10 ppm straw		Not given
Flenewiski,C.A. *et al.* 00004659	Wheat	1975	Oregon	MCPA (0.75 lbs a.e./A)+ Avenge (1.0 lbs/A)	<0.05 ppm grain <0.21 ppm straw	<0.05 ppm Avenge	Not given
Flenewiski,C.A. *et al.* 00004655	Wheat	1975	Minnesota	MCPA (1.0 lbs a.e./A)+ Avenge (1.0 lbs/A)+ Bromoxynil (0.5 lbs/A)	<0.05 ppm grain <0.20 ppm straw		Not given
Crosby,D.G. *et al.* 00004651	Wheat	1974	Oregon	MCPA (0.5 lbs a.e./A)	<0.05 ppm grain <0.10 ppm straw		Not given
Velsicol Chemical Corporation 00004566	Wheat	1972	Idaho	MCPA (0.25 lbs a.e./A)+ Dicamba (0.125 lbs/A)	<0.10 ppm grain <0.39 ppm straw <0.14 ppm grain <0.10 ppm straw	<0.01 ppm Dicamba <0.01 ppm Dicamba <0.01 ppm Dicamba <0.01 ppm Dicamba	Not given
Velsicol Chemical Corporation 00004541	Wheat	1974	No Dakota	MCPA (0.25 lbs a.e./A)+ Dicamba (0.25 lbs/A)	<0.20 ppm grain/straw		Not given
			Nebraska	MCPA (0.25 lbs a.e./A)+ Dicamba (0.25 lbs/A)	<0.05 ppm grain/straw		Not given
			Oregon	MCPA (0.25 lbs a.e./A)+ Dicamba (0.25 lbs/A)	<0.05 ppm grain/straw		Not given
				MCPA (0.33 lbs a.e./A)+ Dicamba (0.17 lbs/A)	<0.05 ppm grain/straw		Not given
Velsicol Chemical Corporation 00004541	Wheat	1974	Washington	MCPA (0.08 lbs a.e./A)+ Dicamba (0.25 lbs/A)	<0.20 ppm grain/straw		Not given
			Montana	MCPA (0.08 lbs a.e./A)+ Dicamba (0.25 lbs/A)	<0.20 ppm grain/straw		Not given

*The MCPA analytical procedures used were validated using MCPA fortified samples. It was not possible to determine from Fiche/Master review papers if a base hydrolysis step was included. Therefore, results should be taken to indicate levels of free MCPA acid.

Table 7.4 Summary Table of Residues in Tissues of Calves

Daily Feeding Rate (ppm MCPA)	Calf Number	Residues in Tissues (ppm)*							
		Muscle		Liver		Kidney		Fat	
		MCPA	Met	MCPA	Met	MCPA	Met	MCPA	Met
250 1/	1765	<0.05	<0.05	<0.05	0.05	1.2	<0.05	<0.05	<0.05
	1649	<0.05	<0.05	0.10	<0.05	2.5	<0.05	0.05	<0.05
	1761	<0.05	<0.05	<0.05	<0.05	0.58	<0.05	<0.05	<0.05
500 2/	1644	<0.05	<0.05	0.08	<0.05	2.0	<0.05	<0.05	<0.05
	1645	<0.05	<0.05	0.15	<0.05	2.2	<0.05	0.06	<0.05
	1646	<0.05	<0.05	0.14	<0.05	2.7	<0.05	<0.05	<0.05
500 2/	1767	<0.05	<0.05	<0.05	<0.05	0.34	<0.05	<0.05	<0.05
	1764	<0.05	<0.05	<0.05	<0.05	0.07	<0.05	<0.05	<0.05
	1647	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05

*All values corrected for recoveries

1/ Fed at 250 or 500 ppm for 28 days, slaughtered on day following last feeding.

2/ Fed at 500 ppm for 28 days, slaughtered on 7th day following last feeding.

Met = Metabolite, 2-methyl-4-chlorophenol.

phenol. Therefore, it is concluded that there are no conjugated residues of MCPA or 2-methyl-4-chlorophenol in these tissues.

In a sheep feeding study (Bjerke et al., 1971, 00004626), nine sheep were subdivided into three groups of three each and fed a diet containing 0, 250 and 500 ppm MCPA for 28 days. Average feed consumption during the feeding period ranged from 25 to 31 kg per animal, with no apparent relationship to the presence of MCPA in the diet. Ingestion rates for MCPA averaged 14.9 and 14.6 mg/kg/day for the two groups on the 500 ppm diet. Residues of MCPA and 2-methyl-4-chlorophenol were determined in the four tissues, muscle, liver, kidney and fat, as in the calf study, using the same analytical method (Dow ACR 71.10). Significant residues were again found in liver and kidney. Withdrawal for six days resulted in a substantial reduction of residue in these tissues (see Summary of Residues in Tissues of Sheep (Table 7-5).

Results of an early cow feeding study (Bache et al., 1964, 00004701), indicate that dietary MCPA data a level of 50 ppm for 4 days did not result in detectable residues of the MCPA in the milk. The level of the phenolic metabolite was not determined.

In a subsequent study (Herman et al., 1970, 00004491; Bjerke et al., 1972, 00003259; and Herman, J.L. et al., 1971, 00004624) three lactating Holstein cows were fed a complete ration containing MCPA at six levels in sequence from 10 to 1000 ppm for 2 or 3 weeks at each level. Three cows were maintained as controls. Six milk samples were collected during each 2-week period (at levels of 10, 30, 100 and 300 ppm), nine samples during the 3-week period, (at 1,000 ppm) and four samples during the 1-week withdrawal period. Cream collected from morning milk only was obtained by compositing the milk from the three test cows and separating to medium heavy cream.

Residues of MCPA greater than 0.05 ppm and up to 0.07 ppm were found in only six samples of milk from cows fed at the 1000 ppm level. Small residues of 0.08 ppm and 0.17 ppm of 2-methyl-4-chlorophenol were found in milk at the 300 and 1000 ppm feeding levels. Residues of both are lower in cream at the 1000 ppm feeding level. Withdrawal resulted in rapid disappearance of residues from the milk, the residues dropped below 0.05 ppm on the first to third day after withdrawal.

The experimental design for the cattle feeding study leaves something to be desired. The dairy cows were given increasing doses of MCPA; that is, they were fed 10 ppm for 2 weeks, 30 ppm for the next 2 weeks, 100 ppm for the next 2 weeks, 300 ppm for the next 2 weeks, and 1000 for the last 2 weeks. This gives the animal's metabolism a chance to acclimate and adapt to the herbicide and possibly develop an increased ability to excrete (or secrete) the herbicide. If untreated cows were given the higher levels without pretreatment, higher residue levels may have resulted in milk. This is important since early results of the FDA survey of ready-to-eat foods indicate the occasional occurrence of MCPA residues in dairy products (Duggan et al., 1967, 0025154). Bache et al. (1964, 00004702) have shown that the animal

Table 7.5 Summary Table of Residues in Tissues of Sheep

Residues in Tissues (ppm)*

Daily Feeding Rate (ppm MCPA)	Sheep Number	Muscle		Liver		Kidney		Fat	
		MCPA	Met	MCPA	Met	MCPA	Met	MCPA	Met
500 1/	2546	<0.05	<0.05	<0.05	<0.05	0.31	<0.05	<0.05	<0.05
	2547	<0.05	<0.05	<0.05	<0.05	1.7	<0.05	<0.05	<0.05
	2553	<0.05	<0.05	0.12	<0.05	0.45	<0.05	<0.05	<0.05
500 2/	2548	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	2549	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	2554	<0.05	<0.05	<0.05	<0.05	3/	<0.05	<0.05	<0.05

*All values corrected for recoveries

1/ Fed at 500 ppm for 28 days, slaughtered on day following last feeding.

2/ Fed at 500 ppm for 28 days, slaughtered on 7th day following last feeding.

3/ Sample lost during analysis.

Met - Metabolite, 2-methyl-4-chlorophenol.

eliminates MCPA at a high rate in urine. Were it not for this high rate of excretion, the criticism of this study might well be valid. It is not expected that MCPA will be preferentially secreted in milk under these circumstances.

There are no residue data for poultry and eggs.

With the realization that residues cannot be maintained long at their highest level of 300 ppm (as in pasture and rangeland grasses) owing to inevitable decline of these residues, it is expected that carryover of residues into meat, fat and meat by-products will be less than those observed in the foregoing feeding studies. Therefore the existing tolerances for meat, fat and meat by-products are considered adequate. The one week preslaughter interval gives added assurance of this.

Because there is little, if any, residue in the small grains, a staple of poultry rations, there is no expectancy of residues in poultry and eggs, and no need for a tolerance.

Other Sites

Applications of MCPA to other sites, e.g., ornamentals, rights-of-way, agricultural, commercial and industrial premises; and aquatic, forest, chapparal, non-agricultural and wasteland areas were formally regarded as non-food uses. It is now recognized that such is not always the case.

The application of MCPA to drainage ditch banks may contaminate water, the fish and shellfish inhabiting it, and eventually potable water. If the contaminated water is used for irrigation there may be contamination of crops. Therefore, this use should be the subject of a tolerance or the subject of labeling restrictions to preclude such contamination.

Another concern is the foraging or grazing by livestock of grass growing on these sites (for example, sheep are allowed to graze on golf courses). If the rates of application are higher (and they are in some instances) than the rate of 2 lbs a.e./acre permitted on pasture grass, then an appropriate restriction e.g., "Do not spray areas likely to be foraged or grazed by livestock" shouldbe imposed. Such is the case for rights-of-way and fallow land.

Current Tolerance Information

Under section 180.339 of CFR 40, tolerances are established for residues of MCPA from application of the herbicide in its acid form or in the form of its sodium, ethanolamine, diethanolamine, triethanolamine, diisopropanolamine, triisopropanolamine or dimethylamine salts or its isooctyl or butoxyethyl esters in or on raw agricultural commodities as follows:

Commodity	Parts per million
Barley, forage	20
Barley, grain	0.1 (N)
Barley, straw	2
Flax, straw	2
Flaxseed	0.1 (N)
Grasses, pasture	300
Grasses, rangeland	300
Grass, hay	20
Oats, forage	20
Oats, grain	0.1 (N)
Oats, straw	2
Peavines	0.1 (N)
Peavines, hay	0.1 (N)
Rice, grain	0.1 (N)
Rice, straw	2
Rye, forage	20
Rye, grain	0.1 (N)
Rye, straw	2
Sorghum, fodder	20
Sorghum, forage	20
Sorghum, grain	0.1
Vegetables seed and pod	0.1
Wheat, grain	0.1 (N)
Wheat straw	2
Wheat, forage	20

Tolerances are also established for combined negligible residues (N) of MCPA and its metabolite 2-methyl-4-chlorophenol in or on the following raw agricultural commodities:

Commodity	Parts per million
Cattle, fat	0.1 (N)
Cattle, mbyp	0.1 (N)
Cattle, meat	0.1 (N)
Goats, fat	0.1 (N)
Goats, mbyp	0.1 (N)
Goats, meat	0.1 (N)
Hogs, fat	0.1 (N)
Hogs, mbyp	0.1 (N)
Hogs, meat	0.1 (N)
Horses, fat	0.1 (N)
Horses, mbyp	0.1 (N)
Horses, meat	0.1 (N)
Milk	0.1 (N)
Sheep, fat	0.1 (N)
Sheep, mbyp	0.1 (N)
Sheep, meat	0.1 (N)

Tolerance Reassessment

Theoretical Maximum Residue Contribution

Tolerances for residues of MCPA, and of its metabolite 2-methyl-4-chlorphenol have been established for a number of food and feed commodities (see previous section). Based on these tolerances, the theoretical maximum residues contribution (TMRC) and MCPA and its metabolite to the human diet is calculated to be ca 0.77 mg/day (assuming a 1.5 kg diet). For a comparison of the TMRC with the maximum permissible daily intake (see the Regulatory Chapter of this Standard--Chapter 2).

International Tolerances:

Codex maximum residue limits (MRLs) have not been recommended for MCPA. Tolerances have not been established in Canada or Mexico for residues of MCPA in any food or feed commodities.

Enforcement/Monitoring Actions

There is no record of any enforcement action involving MCPA. Its residues are not usually monitored in FDA or USDA surveillance programs. Owing to weaknesses in the residue data on the grains, and reservations over the methodology for meat and milk, monitoring of the grains, meat and milk is recommended.

Labeling Requirements

The limitations against foraging and grazing should be consistently maintained. There are, for example, different foraging and grazing limitations for barley for different salts. Unless there is some compelling reason for these differences, they should be removed in the interest of consistency. The following should provide assurance that the tolerances for meat, fat and meat by-products and for milk will not be exceeded:

> "Do not forage or graze meat animals on treated areas within 7 days of slaughter."
>
> "Do not forage or graze dairy animals on treated areas within 7 days after treatment."

Until a tolerance for residues of MCPA in potable water, fish and shellfish is established, the use of MCPA on drainage ditch banks should not be permitted without labeling restrictions to prevent contamination of potable water, fish, or shellfish. If there is a probability that the ditch water is used for irrigation, then some accomodation should be made for residues in irrigated crops.

A restriction against the practice of growing crayfish or catfish in treated rice fields is recommended to preclude the possibility of residues in crayfish or catfish.

For other so-called non-food uses, when the application rate exceeds 2 lbs a.e./acre, an appropriate restriction, e.g., "Do not spray areas likely to be foraged or grazed by livestock" should be imposed. Such is the case for rights-of-way and fallow land.

CHAPTER VIII

ECOLOGICAL EFFECTS OF MCPA

Introduction

In order to evaluate potential fish and wildlife effects resulting from the use of MCPA, the Agency requires certain toxicity testing. Depending on the characteristics and uses of MCPA end-use formulated products, data requirements for wildlife and aquatic organisms can be completely or partially fulfilled with tests on the manufacturing-use products. However, for some end-use formulations which contain salts and esters of MCPA which are not registered MUP's, the technical grade of the ester or the manufacturing-use salt in the product must be tested. Additional testing on specific end-use products can also be required if a particular inert ingredient is determined to significantly alter the toxicity of the active ingredient.

A full battery of fish and wildlife testing is required on MCPA acid. This includes acute oral avian testing, fish acute LC_{50} testing, acute toxicity testing on aquatic invertebrates, and acute estuarine and marine invertebrate toxicity testing. In addition, avian dietary LC_{50} testing in one species (bobwhite quail), fish acute LC_{50} testing in two species, and acute estuarine and marine invertebrate toxicity testing is required on the following salts and esters: sodium salt, dimethylamine salt, butoxyethyl ester, and isooctyl ester.

Because MCPA has an aquatic use, involving direct application to water (use in rice), the Agency is required to consider the need for additional testing on end-use formulations. The only end-use formulation that requires additional testing is the emulsifiable concentrate formulated with the butoxyethyl ester of MCPA. Fish acute LC_{50} testing in two species, acute toxicity testing on aquatic invertebrates, and acute estuarine and marine invertebrate toxicity testing is required on this formulation.

Ecological Effects Profile

Results from the acute aquatic studies on technical MCPA acid suggest that MCPA is slightly toxic to freshwater fish. The calculated LC_{50} values for rainbow trout and bluegills were 89 to 91 ppm and 97 ppm (USEPA, 1976, GS 0017-108) respectively. The 48-hour Daphnia magna toxicity test produced an LC_{50} >180 ppm (USEPA,1976, GS 0017-108), which suggested that MCPA acid is practically nontoxic to freshwater invertebrates. There were no ecologic effects data concerning aquatic organisms available on any manufacturing-use MCPA salts or esters. Two formulations of MCPA also appeared to be practically nontoxic to freshwater fish. The 96-hour LC_{50} for freshwater fish ranged from 180 to 1000 ppm (LE0026927) for MCPA sodium salt formulations. The 96-hour LC_{50} for freshwater fish was greater than 180 ppm for MCPA dimethylamine salt formulation (USEPA, 1972, GS 0017-104).

Results from acute dietary studies on technical MCPA acid suggest that MCPA is practically nontoxic to birds. The calculated LC_{50} values for mallard duck, bobwhite quail, and ring-necked pheasant were greater than 2000 ppm (Dewitt, 1962, GS 0017-101).

MCPA was relatively nontoxic to honey bees.

Data Requirements and Data Gaps

1. Manufacturing-use MCPA (acid, salts, esters)

The following acute wildlife and aquatic organism tests were needed on technical MCPA (acid) in order to perform a hazard evaluation:

a) Estuarine and marine organism toxicity study (preferably 96-hour LC_{50} on shrimp and fish, and either a 48-hour LC_{50} oyster embryolarvae or a 96-hour EC_{50} shell deposition for molluscs). 163.72-3.

b) Avian single-dose oral LD_{50} testing performed on one avian species (preferably mallard duck or bobwhite quail). 163.71-1

The following acute wildlife and aquatic organism tests are needed on technical MCPA butoxyethyl ester and isooctyl ester, and the manufacturing-use products containing the MCPA sodium salt and dimethylamine salt:

a) Acute 96-hour fish studies on coldwater species (preferably rainbow trout) and a warmwater species (preferably bluegill sunfish). 163.72-1

b) Acute 48-hour toxicity studies on a freshwater invertebrate (preferably Daphnia magna). 163.72-2

c) Acute estuarine and marine organism toxicity studies (preferably 96-hour LC_{50} for shrimp and fish, and either a 48-hour LC_{50} oyster embryolarvae testing or a 96-hour EC_{50} mollusk shell deposition testing). 163.72-3

d) Avian acute dietary LC_{50} testing performed on one species of waterfowl (preferably mallard duck) and one species of upland game bird (preferably bobwhite quail or ring-necked pheasant). 163.71-2

e) Avian single-dose oral LD_{50} testing performed on one avian species (preferably mallard duck or bobwhite quail). 163.71-1

Additional chronic fish and wildlife testing may be required after review of the acute toxicity studies on the technical (acid and esters) or manufacturing-use (salts) material.

2. Formulated Product(s)

The direct application of MCPA to water (rice use) triggers a potential hazard to aquatic organisms. The following acute toxicity studies will be required on the butoxyethyl ester formulation of MCPA:

a) Acute 96-hour fish studies on one coldwater species (preferably rainbow trout) and one warmwater species (preferably bluegill sunfish).

b) Acute 48-hour toxicity study on a freshwater invertebrate (preferably Daphnia magna).

c) Acute estuarine and marine toxicity studies (preferably 96-hour LC_{50} on shrimp and fish, and either a 48-hour LC_{50} oyster embryolarvae or a 96-hour LC_{50} shell deposition for molluscs).

Topical Discussions

Effects on Freshwater Fish

Sixteen studies (contained in twelve references) were received and evaluated under this topic. These sixteen studies were acceptable for use in a hazard assessment.

Author	ID
Hattula	05008234
USEPA	GS 0017-108
Sleight	00022698
Bentley	00004512
Pitcher	00026927
Tooby	05020144
McCann	00026928
Buchanan	GS 0017-002
USEPA	GS 0017-107
USEPA	GS 0017-104
USEPA	GS 0017-105
USEPA	GS 0017-106

In order to establish the acute toxicity of MCPA to fish, two 96-hour acute aquatic studies are required on the technical material. These studies should be performed on one coldwater species (preferably rainbow trout) and one warmwater species (preferably bluegill). Since there are aquatic uses involved, formulated product testing is also required.

MCPA Acid

Two acute aquatic studies (USEPA, 1976, GS 0017-108) were conducted by the USEPA laboratory at Beltsville on technical grade MCPA (94% a.i.). The studies were performed on rainbow trout and bluegill sunfish, and were acceptable for fulfilling the Guideline requirements for MCPA acid. The toxicity values were calculated as follows: rainbow trout 96-hour LC_{50} = 89-91 ppm; bluegill sunfish 96-hour LC_{50} = 97 ppm. These values suggest that MCPA acid is slightly toxic to fish.

Salts and Esters

Five studies on the 24% sodium salt formulation were submitted (Bentley, 1974,000004512; Picher, 1973, 000026927; USEPA, 1973, GS 0017-105; USEPA, 1973, GS 0017-106). All were acceptable for fulfilling the Guideline requirements on this formulation. The calculated LC_{50} values ranged from 180 ppm to greater than 1000 ppm, suggesting the MCPA sodium salt is practically nontoxic to fish.

Five studies were evaluated on the 52% dimethylamine salt formulation (USEPA, 1973, GS 0017-107; McCann, 1972, 000026928; USEPA, 1972, GS 0017-104). All were acceptable in fulfilling the Guideline requirements on this formulation. The calculated LC_{50} values were greater than 180 ppm for bluegill and trout. These findings suggest that the dimethylamine salt of MCPA is practically nontoxic to fish.

No studies were submitted on the technicals of the butoxyethyl ester, the butyl ester, the isooctyl ester, the mixture of butyl/isopropyl esters, the mixture of isobutyl, isopropyl, and butyl esters, or the manufacturing-use products containing the sodium salt, the dimethylamine salt, or the diethanolamine salt.

Studies were not submitted on the butoxyethyl ester formulation of MCPA. Since this formulation (emulsifiable concentrate) is used on rice, 96-hour acute fish studies on trout and bluegill are required on each of the formulated products in order to assess the potential hazard to fish.

One study (Hattula, 1977, 05008234) was submitted on residue uptake on the primary metabolite and contaminant of MCPA, 4-chloro-o-cresol. This study appears scientifically sound; however, there are no Guideline requirements regarding residue analysis. Information from this study suggests that the primary metabolite and contaminant of MCPA, 4-chloro-o-cresol, will bioaccumulate only moderately and cause damage to gills and kidneys in fish.

Mixtures of MCPA with Other Active Ingredients

Four studies were submitted on MCPA mixtures. (Sleight, 1973, 0022698; Buchanan, 1980, GS 0017-002; Tooby, 1975, 05020144; Bentley, 1974, 00004512).All were acceptable for fulfilling possible Guideline requirements. Mondak TP658 (dicamba + MCPA) was tested on rainbow trout and bluegill, producing toxicity values greater than 1000 mg/l for the 96-hour acute toxicity to fishPresco S (mecoprop + MCPA + 2,3,-6 Trichlorobenzion acid) was tested on harlequin fish and produced an LC_{50} = 5600 mg/l. This mixture appeared to be practically nontoxic to fish. Weedar 64A/MCPA (2,4-D + MCPA) was tested on rainbow trout and bluegill, producing an LC_{50} >1030 mg/l and >75 <1000 mg/l, respectively. These findings suggested that this mixture was practically nontoxic to fish.

Effects On Estuarine and Marine Organism

Two studies (contained in one reference) were received and evaluated under this topic. These studies are scientifically sound and were acceptable for use in a hazard assessment.

Author	ID
Union Carbide	00022673

Estuarine and marine organism toxicity tests on technical and formulated pesticides are required to support registration if there is an intended direct application to an estuarine or marine environment, or if the pesticide may be expected to enter these environments in significant concentration because of use or mobility pattern. These studies include acute LD_{50} testing on shrimp, oysters, and estuarine fish.

The use pattern for MCPA includes rice. Costal rice acreage in Louisiana and Texas accounts for about 792,000 acres. The proximity of this large acreage to estuarine or marine environments justifies the need for estuarine and marine organisms toxicity studies on the technical, as well as the formulated product.

MCPA Acid

No studies were submitted on MCPA acid. The Guideline requirements for an acute LC_{50} on estuarine and marine organisms on technical (acid) MCPA have not been satisfied. Depending upon the results of these studies, additional chronic tests on mysid shrimp and/or sheepshead minnow may be required.

Salts and Esters

No studies were submitted on the technicals of the butyl ester, the butoxyethyl ester, the mixture of the butyl and isopropyl esters, or the manufacturing-use products containing the sodium or dimethylamine salts. Acute testing on estuarine and marine organisms is required in order to establish the toxicity of the technicals.

Acute estuarine and marine studies on the butoxyethyl ester formulation is required because of the use of MCPA on rice. However, acute studies on the formulations of the sodium salt, the dimethylamine salt, and the mixture of the butyl and isopropyl esters are not required, since the inert ingredients (other than water) account for less than 4% of the total formulation.

Mixtures of MCPA with Other Active Ingredients

Two studies on the mixture Mondak 5P48 (dicamba + MCPA) were submitted, but only one study (Union Carbide, 1975; 000022673) was acceptable for fulfilling possible Guideline requirements on a mixture. The results of this acute marine invertebrate test (LC_{50} = 44.8 mg/l) suggest that this mixture is slightly toxic to grass shrimp.

Effects on Freshwater Aquatic Invertebrates

Two studies were received and evaluated under this topic. Both studies appeared scientifically sound and were acceptable for use in a hazard assessment.

Author	ID
USEPA	GS 0017-108
Union Carbide	00022504

In order to establish the acute toxicity of MCPA to aquatic freshwater invertebrates, a 48-hour acute aquatic study is required on the technical material. Test organisms should be first instar Daphnia magna or early instar amphipods, stoneflies, or mayflies. Since aquatic uses are involved, formulated product testing is also required.

MCPA Acid

One acute aquatic study (USEPA, 1976, GS 0017-108) was conducted by the USEPA laboratory at Beltsville on technical grade MCPA acid (94% a.i.). This daphnid study was acceptable for fulfilling Guideline requirements. The calculated 48-hour LC_{50} value was greater than 180 ppm. This finding suggests that MCPA technical (acid) is practically nontoxic to aquatic freshwater invertebrates.

Salts and Esters

No studies were submitted on the technicals of the butyl ester, the butoxyethyl ester, the mixture of butyl and isopropyl esters, or the manufacturing-use products containing the sodium or dimethylamine salts. Acute aquatic LC_{50} testing on daphnids will be required to establish the toxicity for the technicals.

Studies were not submitted on MCPA formulations (salt and esters). Guideline requirements for acute LC_{50} testing on freshwater aquatic invertebrates using these formulations have not been satisfied. The direct application of MCPA to water (rice use) triggers a potential hazard to aquatic organisms. In order to assess the extent of this danger, acute aquatic freshwater invertebrate testing, using the butoxyethyl ester formulation, will be required. However, acute studies on the formulations of the sodium salt, the dimethylamine salt, and the mixture of the butoxy and isopropyl esters is not required, since the inert ingredients (other than water) account for less than 4% of each total formulation.

Mixtures of MCPA with Other Active Ingredients

One study (Union Carbide, 1976, 00022504) on the mixture Mondak 5P48 (dicamba + MCPA) appeared to be acceptable for fulfilling possible Guideline requirements on a mixture. The calculated 48-hour aquatic freshwater invertebrate LC_{50} value was greater than 670 mg/l. This suggests that Mondak 5P48 is practically nontoxic to daphnids.

Effects on Birds

Eight studies were received and evaluated under this topic. Six studies were acceptable for determining MCPA toxicity to birds.

Author	ID
Fink	00028293
Fink	00004544
Fink	00004545
Parke	00004805
DeWitt	GS 0017-101

MCPA Acid

In order to establish the acute toxicity of MCPA to birds, the following test is required using MCPA acid: one avian single-dose oral study on one avian species (preferable mallard duck or bobwhite quail).

Results from acute dietary studies (DeWitt, 1962, GS 0017-101) on mallard ducks, bobwhite quail, and ring-neck pheasant suggest that MCPA acid is practically nontoxic. The calculated dietary LC_{50} values were greater than 2000 ppm for each species tested.

Salts and Esters

No studies were submitted on the technicals of the butoxyethyl ester, the isooctyl ester, the butyl ester, the mixture of butyl and isopropyl esters, the mixture of the isobutyl, isopropyl, and butyl esters, or the manufacturing-use products containing the sodium dimethylamine or diethanolamine salts. Since these compounds are used on crops where birds may be affected, one acute dietary study (bobwhite quail) will be required on each technical compound to assess the potential hazard to avian species.

Mixtures of MCPA with Other Active Ingredients

Three studies on mixtures were reviewed (Fink, 1973, 00028293; Fink, 1973, 00004544; Fink, 1973, 00004545). All were acceptable for fulfilling possible Guideline requirements on a mixture. Mondak TP658 (dicamba + MCPA) was tested on bobwhite quail and mallard duck in two eight-day dietary studies. The acute LC_{50} values were 1155 ppm and 4640 ppm, respectively. These findings suggest that this mixture is slightly toxic to avian species. Banvel 4S + Bromoxynil-MCPA was tested on mallard duck in an acute dietary study. The LC_{50} was greater than 4640 ppm, suggesting slight toxicity to avians.

Effects on Beneficial Insects

Nine studies were received and evaluated under this topic. Seven studies were not acceptable for use in a hazard assessment. The following two studies were acceptable.

Author	ID
Stevenson	05001991
Glynne Jones and Connell	05015632

Table 8-1: Toxicity Studies on Beneficial Insects with MCPA

Species	Formulation	Results	Author	Date	ID#	Fulfills Guideline Requirements
Honey bee (*Apis mellifera*)	Technical	Contact LD_{50} 100 micrograms/ bee. Oral LD_{50} >10 micrograms/bee. (Relatively non-toxic.)	Stevenson	1978	05001991	NA
Honeybee	Technical	Relatively non-toxic through oral exposure	Glynne Jones & Connell	1954	05015632	NA

There is sufficient information to characterize MCPA as low in toxicity to honeybees. There are curently no Guidelines requirements for evaluating toxicity to nontarget insects.

Author	ID
Stevenson	05001991
Glynne Jones and Connell	05015632

Table 8-1: Toxicity Studies on Beneficial Insects with MCPA

Species	Formulation	Results	Author	Date	ID#	Fulfills Guideline Requirements
Honey bee (*Apis mellifera*)	Technical	Contact LD_{50} 100 micrograms/bee. Oral LD_{50} >10 micrograms/bee. (Relatively non-toxic.)	Stevenson	1978	05001991	NA
Honeybee	Technical	Relatively non-toxic through oral exposure	Glynne Jones & Connell	1954	05015632	NA

There is sufficient information to characterize MCPA as low in toxicity to honeybees. There are curently no Guidelines requirements for evaluating toxicity to nontarget insects.

IX BIBLIOGRAPHY

A. Guide to Use of This Bibliography

1. Content of Bibliography

This bibliography has two sections: 1] citations that contributed information useful to the review of the chemical and considered to be part of the data base supporting registrations under the standard; 2] citations examined and judged to be inappropriate for use in developing the standard. The second section of the bibliography is on file with the Agency, and is available for review. Primary sources for studies in this bibliogrphy have been the body of data submitted to EPA and its predecessor agencies in support of past reulatory decisions, and the published technical literature.

2. Units of Entry

The unit of entry in this bibliography is called a "study". In the case of published materials, this corresponds closely to an article. In the case of unpublished materials submitted to the agency, the Agency has sought to identify documents at a level parallel to a published article from within the larger volumes in which they were submitted. The resulting "studies" generally have a distinct title (or at least a single subject), can stand alone for purposes of review, and can be described with a conventional bibliographic citation. The Agency has attempted also to unite basic documents and commentaries upon them, treating them as a single study.

3. Identification of Entries

The entries in this bibliography are sorted by author, date of the document, and title. Each entry bears, to the left of the citation proper, a nine-digit identifier. This number is unique to the citations, and should be used at any time specific reference is required. This number is called the "Master Record Identifier", or "MRID". It is not related to the six-digit "Accession Number" which has been used to identify volumes of submitted data; see paragraph 4(d)(4) below for a further explanation.

4. Form of the Entry

In addition to the Master Record Identifier (MRID), each entry consists of a bibliographic citation containing standard elements followed, in the case of materials submitted to EPA, by a description of the earliest known submission. The bibliographic conventions used reflect the standards for the American National Standards Insitute (ANSI), expanded to provide for certain special needs. Some explanatory notes of specific elements follow:

a. Author

Whenever the Agency could confidently identify one, the Agency has chosen to show a personal author. When no individual was indentified, the Agency has shown an identificable laboratory or testing facility as author. As a last resort, the Agency has shown the first known submitter as author.

b. Document Date

When the date appears as four digits with no question marks, the Agency took it directly from the document. When a four-digit date is followed by a question mark, the bibiographer deduced the date from evidence in the document. When the date appears as (19??), the Agency was unable to determine or estimate the date of the document.

c. Title

This is the third element in the citation. In some cases it has been necessary for the Agency bibliographers to create or enhance a document title. Any such editorial insertions are contained between square brackets.

d. Trailing Parenthesis

For studies submitted to us in the past, the trailing parenthesis include (in addition to any self-explanatory text) the following elements describing the earliest known submission.

1) Submission Date. Immediately following the word 'received' appears the date of the earliest known submission.

2) Administrative Number. The next element, immediately following the work 'under', is the registration number, experimental permit number, petition number, or other administrative number associated with the earliest known submission.

3) Submitter. The third element is the submitter, following the phrase 'submitted by'. When authorship is defaulted to the submitter, this element is omitted.

4) Volume Identification. The final element in the trailing parenthesis identifies the EPA accession number of the volume in which the original submission of the study appears. The six-digit accession number follows the symbol 'CDL', standing for "Company Data Library". This accession number is in turn followed by an alphabetic suffix which shows the relative position of the study within the volume. For example, within accession number 123456, the first study would be 123456-A; the second, 123456-B; the 26th, 123456-Z; and the 27th 123456-AA.

MRID #	CITATION
005019071	Aberg, B.; Eliasson, L. (1978) The herbicidal effects of phenoxy compounds. Pages 86-100, In Chlorinated Phenoxy Acids and Their Dioxins: Mode of Action, Health Risks and Environmental Effects, Report from a Conference; 1977, Stockholm, Sweden. Edited by C. Ramel. Stockholm, Sweden: Swedish Natural Science Research Council. (Ecological bulletins (Stockholm), no. 27)
005008511	Abou Elfadl, M.M.; Fahmy, M. (1958) Effect of sodium 2,4-D and M.C.P.A. on root nodulation of legumes and soil microorganisms. Agricultural Research Review 36:333-338.
000004735	Akzo Zout Chemie Nederland B.V. (1973) Spectrophotometric Determination of Chlorophenol in Phenoxy Acetic Acid or Phenoxy Propionic Acid and Their Salts with 4-Amino Antipyrine. Method Nr. 259.3 dated Feb 12, 1973. (Unpublished study received Feb 20, 1973 under 6305-10; submitted by Robeco Chemicals, Inc., New York, N.Y.; CDL:022388-F)
000004730	Akzo Zout Chemie nv (1971) Gas Chromatographic Determination of (Methyl) (chloro)phenoxyacetic acids and (Methyl) (chloro)-phenoxypropionic acids and Their Salts. Method nr. 247.1 dated Apr 20, 1971. (Unpublished study received Feb 20, 1973 under 6305-10; submitted by Robeco Chemicals, Inc., New York, N.Y.; CDL:022388-A)
005004650	Allard, R.W.; DeRose, H.R.; Swanson, C.P. (1946) Some effects of plant growth-regulators on seed germination and seedling development. Botanical Gazette 107:575-583.
005015044	Allen, F.C. (1966) Tolerance of barley to MCPA and dicamba. Pages 25-27, In Proceedings of the New Zealand Weed and Pest Control Conference. Vol. 19. Hamilton, New Zealand: New Zealand Weed and Pest Control Conference.
000004493	Amchem Products, Incorporated (1968) Summary of Performance Data: Brominal Plus. Summary of studies 002199-B through 002199-P. (Unpublished study received Oct 30, 1968 under 264—239; submitted by Union Carbide Agricultural Products Co., Ambler, Pa.;(CDL: 002199-A)
000004741	American Cyanamid Company (1973) General Summary. (Unpublished study received Sep 19, 1975 under 241-EX-64; CDL:094696-C)

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting Registrations Under the Standard

000004609 American Cyanamid Company (1974) General Summary. Summary of studies 224170-R through 224170-V. (Unpublished study received Jan 8, 1975 under 241-EX-64; CDL:224170-Q)

000004701 Bache, C.A.; Hardee, D.D.; Holland, R.F.; Lisk, D.J. (1964) Absence of Phenoxyacid herbicide residues in the milk of dairy cows at high feeding levels. Journal of Dairy Science XLVII(3):298-299. (Also In unpublished submission received Sep 12, 1968 under 8F0676; submitted by Dow Chemical U.S.A., Midland, Mich.; CDL: 092980-O)

000004702 Bache, C.A.; Lisk, D.J.; Wagner, D.G.; Wagner, R.G. (1964) Elimination of 2-Methyl-4-chlorophenoxyacetic acid and 4-(2-Methyl-4-chlorophenoxybutyric) acid in the urine from cows. Journal of Dairy Science XLVII(1):93-95. (Also In unpublished submission received Sep 12, 1968 under 8F0676; submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:092980-P)

005006168 Bache, C.A.; Lisk, D.J.; Wagner, D.G.; Warner, R.G. (1964) Elimination of 2-methyl-4-chlorophenoxyacetic acid and 4-(2-methyl-4-chlorophenoxybutyric) acid in the urine from cows. Journal of Dairy Science 47(1):93-95.

005012661 Balezina, L.S. (1967) Vliyanie nekotorykh gerbitsidov na razvitie pochvennykh vodoroslei. [Effect of some herbicides on the development of soil algae.] Mikrobiologiya. [Microbiology.] XXXVI(1):163-167.

000004570 Ball, R.W.E.; Soundy, M. (1958) 2,4-DB and MCPB in Lucerne: Part I. The Effect of 2,4-DB and MCPB on the Development of the Lucerne Plant. (Preprint, British Weed Control Conference, November, 1958; unpublished study received Dec 5, 1960 under 359-400; prepared by May & Baker, Ltd., Agricultural and Horticultural Research Station, Eng., submitted by Rhone-Poulenc, Inc., Monmouth Junction, N.J.; CDL:023310-C)

000004454 Bendixen, W.E. (1974) Report of Planned Work Accomplished: Bean Weed Control--Shield Spraying MCPA and 2,4-D: Project No. 19. (Unpublished study received Feb 10, 1976 under 6E1746; prepared by Univ. of California, Agricultural Extension Service in cooperation with California, Dept. of Food and Agriculture, Chemistry Laboratory Services, submitted by Interregional Research Project No. 4, New Brunswick, N.J.; CDL:095368-D)

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting Registrations Under the Standard

MRID #	CITATION
000004512	Bentley, R.E. (1974) Bioassay Report Submitted to Amchem Products, Inc., Ambler, Pennsylvania: Acute Toxicity of Three Amchem Compounds to Bluegill (*Lepomis macrochirus*) and Rainbow Trout (*Salmo gairdneri*). (Unpublished study received Sep 13, 1974 under 264-55; prepared by Bionomics, EG&G, Inc., submitted by Union Carbide Agricultural Products Co., Ambler, Pa.; CDL: 131084-B)
000021975	Biesemeier, J.A.; Argevine, D.M. (1979) Inhalation—EPA. (Unpublished study received Jul 23, 1979 under 39335-1; prepared by Raltech Scientific Services, Inc., submitted by Fallek-Lankro Corp., Tuscaloosa, Ala.; CDL:238870-E)
000004625	Bjerke, E.L.; Herman, J.L. (1971) Residues of 2-Methyl-4-chlorophenoxyacetic acid and 2-Methyl-4-chlorophenol in Tissues of Beef Calves Fed MCPA. (Unpublished study received Oct 11, 1971 under 9F0761; prepared by Dow Chemical Co., submitted by National Agricultural Chemicals Association, Industry Task Force on Phenoxy Herbicide Tolerances, Washington, D.C.; CDL:091311-F)
000004626	Bjerke, E.L.; Herman, J.L. (1971) Residues of 2-Methyl-4-chlorophenoxyacetic acid and 2-Methyl-4-chlorophenol in Tissues of Sheep Fed MCPA. (Unpublished study received Oct 11, 1971 under 9F0761; prepared by Dow Chemical Co., submitted by National Agricultural Chemicals Association, Industry Task Force on Phenoxy Herbicide Tolerances, Washington, D.C.; CDL:091311-G)
005003259	Bjerke, E.L.; Herman, J.L.; Miller, P.W.; Wetters, J.H. (1972) Residue study of phenoxy herbicides in milk and cream. Journal of Agricultural and Food Chemistry 20(5):963-967.
005004641	Bollag, J.M.; Helling, C.S.; Alexander, M. (1967) Metabolism of 4-chloro-2-methylphenoxyacetic acid by soil bacteria. Applied Microbiology 15(6):1393-1398.
GS 0017-002	Buchanan, S., Pell, I.B., Woodhouse, R.N. (1979) Acute Toxicity of MCPA to Mirror Carp and Rainbow Trout. (Unpublished study received Nov 19,1980; submitted by Diamond-Shamrock Corp.)
005015003	Bueno, A.J.; Cabanilla, H.C. (1971) Study on the reaction of recommended rice varieties to early-post and pre-emergence herbicides. Down to Earth 27(3):8-11.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting Registrations Under the Standard

MRID #	CITATION
005016555	Buselmaier, W.; Roehrborn, G.; Propping, P. (1972) Mutagenitaets-Untersuchungen mit Pestiziden im Host-mediated assay und mit dem Dominanten Letaltest an der Maus.
005003491	Byford, W.J.; Prince, J. (1976) Experiments on the effect of hormone weedkillers on sugar beet. Journal of Agricultural Science 86(1):135-139.
005004844	Cessna, A.J.; Grover, R. (1978) Spectrophotometric determination of dissociation constants of selected acidic herbicides. Journal of Agricultural and Food Chemistry 26(1):289-292.
005014225	Chang, W.L. (1969) Performance of granular herbicides for transplanted rice. Nung Yeh Yen Chiu. [Agricultural Research.] 18(4):11-18.
000021917	Chipman, Incorporated (1973) M.C.P. Acid. Includes undated method. (Unpublished study received Jun 20, 1973 under 8203-18; CDL: 005990-A)
000004782	Chipman Chemical Company, Inc. (1967) Effectiveness and Crop Safety Data: SR3/67. (Unpublished study including summary tables and efficacy reports Port 64.12, Port 65.4, Port 65.21, Port 65.22, Port 65.28, Port 66.58, Port 66.60, BB.65.100, BB.65.102, BB.65.151, BB.66.7, BB.66.87, C.65.9, C.65.11, C.65.21, C.65.24, C.65.40, C.65.42, C.65.57, C.66.13, C.66.16, C.66.18, C.66.45, C.66.47, C66.49, C.66.50, PA.64.8, PA.65.2 and weed control summary 1966, received Mar 10, 1967 under 359-601; submitted by Rhone-Poulenc, Inc., Monmouth Junction, N.J.; CDL:023320-B)
005003765	Chow, C.; Montgomery, M.L.; Yu, T.C. (1971) Methodology and analysis for residues of MCP and 2,4,5-T in wheat. Bulletin of Environmental Contamination and Toxicology 6(6):576-580.
005006328	Cohen, S.Z.; Zweig, G.; Law, M.; Wright, D.; Bontoyan, W.R. (1978) Analytical determination of *N* -nitroso compounds in pesticides by the United States Environmental Protection Agency—a preliminary study. Pages 333-342, *In* Environmental Aspects of *N* -Nitroso Compounds. Washington, D.C.: Environmental Protection Agency. (IARC scientific publications, vol. 19)
005003559	Collier, R.H.; Grimes, G.S. (1974) Determination of chlorophenoxy acids in formulations by gas-liquid chromatography of their trimethylsilyl derivatives. Journal of the Association of Official Analytical Chemists 57(4):781-784.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting Registrations Under the Standard

MRID #	CITATION
005003725	Collins, D.J.; Gaunt, J.K. (1970) The metabolic fate of 4-chloro-2-methylphenoxyacetic acid in peas. Biochemical Journal 118(3):54.
000005552	Conkin, R.A. (1956) Procedures for Determining Residues of MCP (2-Methyl-4-chlorophenoxyacetic acid) in Treated Crops. Method dated Oct 29, 1956. (Unpublished study received Dec 18, 1967 under 9F0676; prepared by Monsanto Chemical Co., submitted by National Agricultural Chemicals Association, Industry Task Force on Phenoxy Herbicide Tolerances, Washington, D.C.; CDL:092981-A)
005004651	Crosby, D.G.; Bowers, J.B. (1966) Determination of 2,4-D residues in animal products. Bulletin of Environmental Contamination and Toxicology 1(3):104-107.
005009423	DaSilva, E.J.; Henriksson, L.E.; Henriksson, E. (1974) Effect of pesticides on nitrogen fixation by blue-green algae. Revista de Microbiologia 5(4):73-74.
005005265	DaSilva, E.J.; Henriksson, L.E.; Henriksson, E. (1975) Effect of pesticides on blue-green algae and nitrogen-fixation. Archives of Environmental Contamination and Toxicology 3(2):193-204.
005009865	DaSilva, E.J.; Henriksson, L.E.; Udris, M. (1977) Growth responses of mycorrhizal *Boletus* and *Rhizopogon* species to pesticides. Transactions of the British Mycological Society 68(3):434-437.
005004661	De, B.K.; Mukhopadhyay, S. (1971) Effect of MCPA and Stam F-34 on the occurrence of some nutritional groups of bacteria in the rice fields of West Bengal. International Rice Commission Newsletter 20(3):35-40.
000004442	Del Monte Corporation (1968) MCPA Residues on Peas and Pea Vines: Del Monte Code No. 19708. (Unpublished study received on unknown date under 9F0761; submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:092000-H)
000004443	Del Monte Corporation (1968) MCPA Residues on Peas and Pea Vines: Del Monte Code No. 19708. (Unpublished study received on unknown date under 9F0761; submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:092000-H)
000004444	Del Monte Corporation (19??) Trails with the sodium salt of MCPA for weed control inpeas. (Unpublished study conducted by Donald W. Davis, Utah State University, Logan, Utah; PCC 73-E-21).

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting Registrations Under the Standard

MRID #	CITATION
005011096	DeRose, H.R. (1946) Persistence of some plant growth-regulators when applied to the soil in herbicidal treatments. Botanical Gazette 107:583-589.
000004764	Devine, J.M. (1970) Report on MCPA Residues in Rough Rice & Rice Straw. Includes two undated methods. (Unpublished study received Jan 22, 1971 under 9F0761; prepared by Syracuse Univ. Research Corp., submitted by National Agricultural Chemicals Association, Industry Task Force on Phenoxy Herbicide Tolerances, Washington, D.C.; CDL:091308-L)
GS 0017-101	DeWitt, J.B. et *al*., Effects of Pesticides on Fish and Wildlife, USDI, F&W *Circ.* 143 pp 4,5,33,45, 1962
005012898	Domingo, I.S.; Palis, G.T. (1966) Chemical weed control experiment in upland rice at the La Granja Experiment Station. Philippine Journal of Plant Industry 31(3):145-156.
005004273	Dorschner, K.P.; Buchholtz, K.P. (1956) Wetting ability of aqueous herbicidal sprays as a factor influencing stands of alfalfa seedlings. Agronomy Journal 48(2):59-63.
000025154	Duggan, R.E.; Barry, H.C.; Johnson, L.Y. (1967) Residues in food and feed: Pesticide residues in total diet samples (II). Pesticides Monitoring Journal 1(2):2-12. (Also *In* unpublished submission received Nov 5, 1970 under 1F1060; submitted by Velsicol Chemical Corp., Chicago, Ill.; CDL:099195-U)
005006190	Edmond, D.B. (1956) The effect of MCPB (sodium 2-methyl-4-chlorophenoxybutyrate) on young red clover (*Trifolium pratense*) and weeds. New Zealand Journal of Science and Technology, Section A 38(4):397-402.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
000004659	Elenewski, C.A.; Wang, T. (1975) Avenge^{R} (CL 84,777): Determination of CL 84,777 (1,2-Dimethyl-3,5-diphenyl-1H-pyrazolium methyl sulfate), Bromoxynil (3,5-Dibromo-4-hydroxylbenzonitrile) and MCPA (2-Methyl-4-chlorophenoxyacetic acid) Residues in Wheat Grain and Straw Following Ground Application of Avenge Alone and in combination with MCPA or Bromoxynil, (Oregon): Report No. C-820. (Unpublished study received Nov 14, 1975 under 6F1703; prepared in cooperation with Biodynamics, Inc., submitted by American Cyanamid Co., Princeton, N.J.; CDL:094738-AH)
000004655	Elenewski, C.A.; Wang, T. (1975) Avenge^{R} (CL 84,777): Determination of CL 84,777 (1,2-Dimethyl-3,5-diphenyl-1H-pyrazolium methyl sulfate), Bromoxynil (3,5-Dibromo-4-hydroxylbenzonitrile) and MCPA (2-Methyl-4-chlorophenoxyacetic acid) Residues in Durum Wheat Grain and Straw Following Aerial Application of Avenge Alone and in Combination with MCPA or Bromoxynil, (Minnesota): Report No. C-823. (Unpublished study received Nov 14, 1975 under 6F1703; prepared in cooperation with Biodynamics, Inc., submitted by American Cyanamid Co., Princeton, N.J.; CDL:094738-AD)
005006302	Elliott, B.R.; Lumb, J.M.; Reeves, T.G.; Telford, T.E. (1975) Yield losses in weed-free wheat and barley due to post-emergence herbicides. Weed Research 15(2):107-111.
005003256	Elo, H. (1976) Distribution and elimination of 2-methyl-4-chlorophenoxyacetic acid (MCPA) in male rats. Acta Pharmacologica et Toxicologica 39(1):58-64.
005004181	Elo, H.; Parvinen, M. (1976) Effect of sodium 2-methyl-4-chlorophenoxyacetate on spermatogenesis in the rat. Journal of Reproduction and Fertility 48:243-244.
005006041	Erdelska, O. (1966) The effect of 2-methyl-4-chlorophenoxyacetic acid on the development of Hordeum distichum L. Ovule. Biologia Plantarum 8(2):117-121.
005008355	Eronen, L.; Julkunen, R.; Saarelainen, A. (1979) MCPA residues in developing forest ecosystem after aerial spraying. Bulletin of Environmental Contamination and Toxicology 21(6):791-798.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
005003766	Faulkner, J.K.; Woodcock, D. (1965) Fungal detoxication. Part VII. Metabolism of 2,4-dichlorophenoxyacetic and 4-chloro-2-methylphenoxyacetic acids by *Aspergillus niger* . Journal of the Chemical Society :1187-1191.
000028293	Fink, R.; Broughton, W.S., Jr. (1973) Final Report: Eight-Day Dietary LC_{50}—Mallard Ducks: Project No. 686-136. (Unpublished study received Feb 18, 1976 under 876-25; prepared by Hazleton Laboratories, Inc., submitted by Velsicol Chemical Corp., Chicago, Ill.; CDL:225100-K)
000004544	Fink, R.; Broughton, W.S., Jr. (1973) Final Report: Eight-Day Dietary LC_{50}—Bobwhite Quail: Project No. 686-137. (Unpublished study received Dec 11, 1974 under 876-45; prepared by Hazelton Laboratories, Inc., submitted by Velsicol Chemical Corp., Chicago, Ill.; CDL:003548-E)
000004545	Fink, R.; Broughton, W.S., Jr. (1973) Final Report: Eight-Day Dietary LC_{50}—Mallard Ducks: Project No. 686-138. (Unpublished study received Dec 11, 1974 under 876-45; prepared by Hazelton Laboratories, Inc., submitted by Velsicol Chemical Corp., Chicago, Ill.; CDL:003548-F)
005003428	Fisher, P.R.; Appleton, J.; Pemberton, J.M. (1978) Isolation and characterization of the pesticide-degrading plasmid pJP1 from *Alcaligenes paradoxus* . Journal of Bacteriology 135(3):798-804.
005005788	Fletcher, W.W.; Raymond, J.C. (1956) Toxicity and breakdown of "hormone" herbicides. Nature 178(4525):151-152.
005005860	Flinchum, W.T.; Stansel, J.W. (1972) Effects of applications of phenoxy herbicides on Bluebelle rice yields and dayflower control. Pages 21-24, *In* Texas Agricultural Experiment Station Progress Report. College Station, Tex.: Agricultural Experiment Station.
005005531	Flinchum, W.T.; Westfall, D.G.; Stansel, J.W. (1973) Effects of phenoxy herbicides on yield of first and second crop rice. Pages 1-3, *In* Texas Agricultural Experiment Station Progress Report No. PR-3177. College Station, Tex.: Texas Agricultural Experiment Station, TexasA & M University.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
005019954	Frank, R.; Sirons, G.J.; Ripley, B.D. (1979) Herbicide contamination and decontamination of well waters in Ontario, Canada, 1969-78. Pesticides Monitoring Journal 13(3):120-127.
000004473	Frost, K.R., Jr. (1966) Weed Control Headlines 1965-1966. (Unpublished study received Nov 6, 1967 under 464-398; prepared by South Dakota State Univ., submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:003622-R)
005006578	Fryer, J.D.; Kirkland, K. (1970) Field experiments to investigate long-term effects of repeated applications of MCPA, tri-allate, simazine and linuron: report after 6 years. Weed Research 10(2):133-158.
005014496	Fykse, H. (1975) Untersuchungen ueber *Sonchus arvensis* L.: II. Translokation von 14C-MCPA unter verschiedenen Bedingungen.
005013377	Fykse, H. (1976) Untersuchungen ueber *Sonchus arvensis* L.: III. Metabolismus von MCPA. [Investigations with *Sonchus arvensis* L: III. Metabolism of MCPA. Weed Reserach 16(5):309-316.
000004513	Gabriel, K.L. (1971) Draize Eye Irritation--Rabbits. (Unpublished study received Nov 16, 1971 under 264-36; prepared by Biosearch, Inc., for Amchem Products, Inc., submitted by Union Carbide Agricultural Products Co., Ambler, Pa.; CDL:100823-A)
005005451	Gamar, Y.; Gaunt, J.K. (1971) Bacterial metabolism of 4-chloro-2-methylphenoxyacetate: formation of glyoxylate by side-chain cleavage. Biochemical Journal 122(4):527-531.
005004565	Gardner, K.; Overton, K.C. (1960) Analysis of MCPA/TBA herbicide formulations: II. A gas-liquid chromatographic method for the determination of 4-chloro-2-methyl phenoxyacetic acid. Analytica Chimica Acta 23:337-345.
005003416	Gaunt, J.K.; Evans, W.C. (1971) Metabolism of 4-chloro-2-methylphenoxyacetate by a soil pseudomonad: preliminary evidence for the metabolic pathway. Biochemical Journal 122(4):519-526.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
000041634	Gilbert, C.M., Hopkins, R.; MacDonald, C.M.; et al. (1978) The Metabolic Fate of (14C)-MPCA (4-Chloro-1-methyl(Ring-U-14C) phenoxyacetic acid) in the Rat: Report No., 1334R3-277/1. (Unpublished study including submitter summary, received Sep 4, 1980 under 2217-EX-2; prepared by Hazleton Laboratories Europe, Ltd. and Boots Co., Ltd., cubmitted by PBI-Cordon Corpt., Kanasa City, Kans.; CDL:243193-A)
005005888	Gillberg, B.O. (1971) On the effects of some pesticides on Rhizobium and isolation of pesticide-resistant mutants. Archives of Microbiology 75(3):203-208.
005015632	Glynne Jones, G.D.; Connell, J.U. (1954) Studies of the toxicity to worker honey-bees (Apis mellifera L.) of certain chemicals used in plant protection. Annals of Applied Biology 41(2):271-279.
000020121	Grogan, B.; Hahner, J.; Hayner, J.; et al. (1970) Diuron plus Bromoxynil--Winter Wheat. (Unpublished study including letter dated Jun 1, 1970 from A.A. Baber to file, received Jan 26, 1971 under 352-247; submitted by E.I. du Pont de Nemours & Co., Wilmington, Del.; CDL:002858-A)
005015630	Grossbard, E. (1971) The effect of repeated field applications of four herbicides on the evolution of carbon dioxide and mineralization of nitrogen in soil. Weed Research 11(4):263-275.
000004766	Guardigli, A. (1970) MCPA Residues in Flax Seed: Field Test Project No. STP 69-26; 69-27. Includes method no. 104 dated Nov 25, 1969. (Unpublished study received Jan 22, 1971 under 9F0761; prepared by Rhodia, Inc. in cooperation with Univ. of Minnesota and North Dakota State Univ. of Agriculture and Applied Science, submitted by National Agricultural Chemicals Association, Industry Task Force on Phenoxy Herbicide Tolerances, Washington, D.C.; CDL:091308-O)
000021920	Guardigli, A. (1973) Rhodia Analytical Method No. 122: Electron Capture GLC Residue Measurement of Total 2-Methyl-4-chlorophenoxyacetic acid, MCPA, after Formation of Its Nitro Derivatives and Esterification to Its Methyl Ester, and TLC Residue Determination of Total Chlorophenols. Method dated Oct 1973. (Unpublished study received Oct 3, 1975 under 6E1681; submitted by Rhone-Poulenc Chemical Co., Monmouth Junction, N.J.; CDL: 097351-B)

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
000004787	Guardigli, A. (1974) Rhodia Analytical Method No. 123. Includes two methods dated March 1974. (Unpublished study received Jan 30, 1976 under 359-534; prepared by Rhodia, Inc., submitted by Rhone-Poulenc, Inc., Monmouth Junction, N.J.; CDL:222737-A)
000004788	Guardigli, A. (1974) MCPB Sodium Salt in Peas: Aerial Applications. (Unpublished study received Jan 30. 1976 under 359-534; prepared by Rhodia, Inc., submitted by Rhone-Poulenc, Inc., Monmouth Junction, N.J.; CDL:222737-B)
000004449	Guardigli, A.; Henckler, P.M. (1973) Final Summary: MCPA and Phenol Metabolite in Pasture and/or Range Grasses. (Unpublished study received on unknown date under 9F0761; prepared by Rhodia, Inc., submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:092001-F)
000022569	Gurd, M.R.; Harmer, G.L.M.; Lessel, B. (1964) The Toxicity of Mecoprop and MCPA to Rats: Report No. 1254. (Unpublished study received Jan 21, 1965 under unknown admin. no.; prepared by Boots Pure Drug Co., Ltd., submitted by ; CDL:102704-A)
000004822	Guyton, C.L. (1977) Procedures for the Measurement of Asulam, MCPA, Sulfanilamide and Acetylasulam in/on Flax: Forages, Straw, Seed and Mill-Processed Flax Seed Fractions. Method no. 143 dated Jul 1977. (Unpublished study received Apr 13, 1979 under 359-662; prepared by Rhodia, Inc., submitted by Rhone-Poulenc, Inc., Monmouth Junction, N.J.; CDL:238025-B)
000021977	Harwell, C. (1978) A Gas Chromatography Method for Determination of 2 Methyl 4 Chlorophenoxyacetic acid and Impurities in Technical MCPA. Method no. 1A/1/2 dated Jan, 1978. (Unpublished study received Jul 23, 1979 under 39335-1; submitted by Fallek-Lankro Corp., Tuscaloosa, Ala.; CDL:238871-A)
005003795	Hattula, M.L.; Elo, H.; Reunanen, H.; Arstila, A.U.; Sorvari, T.E. (1977) Acute and subchronic toxicity of 2-methyl-4-chlorophenoxyacetic acid (MCPA) in male rat. I. Light microscopy and tissue concentrations of MCPA. Bulletin of Environmental Contamination and Toxicology 18(2):152-159.
005016652	Helling, C.S. (1971) Pesticide mobility in soils: II. Applications of soil thin-layer chromatography. Proceedings of the Soil Science Society of America 35(5):737-743.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
005004203	Helling, C.S.; Turner, B.C. (1968) Pesticide mobility: determination by soil thin-layer chromatography. Science 162(3853):562-563.
000004492	Herman, J.L.; Bjerke, E.L. (1970) Determination of MCPA and 2-Methyl-4-chlorophenol in Milk and Cream by Gas Chromatography. Method no. ACR 70.17 dated Dec 2, 1970. (Unpublished study received Jan 11, 1971 under 9F0761; prepared by Dow Chemical Co., submitted by National Agricultural Chemicals Association, Industry Task Force on Phenoxy Herbicide Tolerances, Washington, D.C.; CDL:091313-J)
000004627	Herman, J.L.; Bjerke, E.L. (1971) Determination of MCPA and 2-Methyl-4-chlorophenol in Cattle and Sheep Tissues by Gas Chromatography. Method ACR 71.10 dated Jun 24, 1971. (Unpublished study received Oct 11, 1971 under 9F0761; prepared by Dow Chemical Co., submitted by National Agricultural Chemicals Association, Industry Task Force on Phenoxy Herbicide Tolerances, Washington, D.C.; CDL:091311-H)
000004491	Herman, J.L.; Bjerke, E.L.; Getzendaner, M.E. (1970) Residue of 2-Methyl-4-chlorophenoxyacetic acid and 2-Methyl-4-chlorophenol in Milk and Cream from Cows Fed MCPA. (Unpublished study received Jan 11, 1971 under 9F0761; prepared by Dow Chemical Co., submitted by National Agricultural Chemicals Association, Industry Task Force on Phenoxy Herbicide Tolerances, Washington, D.C.; CDL:091313-I)
000004624	Herman, J.L.; Bjerke, E.L.; Getzendaner, M.E. (1971) Residues of 2-Methyl-4-chlorophenoxyacetic acid and 2-Methyl-4-chlorophenol in Milk and Cream from Cows Fed MCPA. (Unpublished study received Oct 11, 1971 under 9F0761; prepared by Dow Chemical Co., submitted by National Agricultural Chemicals Association, Industry Task Force on Phenoxy Herbicide Tolerances, Washington, D.C.; CDL:091311-E)
005021236	Herzel, F.; Schmidt, G. (1979) [Testing the leaching behavior of herbicides on lysimeters and small columns.] WaBoLu-Berichte (3):1-16.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
000004632	Higham, J.W. (1974) The Gas Chromatographic Determination of MCPA (2-Methyl-4-chlorophenoxyacetic acid) and Bromoxynil (3,5-Dibromo-4-hydroxybenzonitrile) in Fortified Wheat Grain and Straw: Report No. C-575. (Unpublished study received Nov 14, 1975 under 6F1703; prepared in cooperation with State Univ. of New York--Oswego, Lake Ontario Environmental Laboratory, submitted by American Cyanamid Co., Princeton, N.J.; CDL:094738-D)
000004633	Higham, J.W. (1975) The Gas Chromatographic Determination of MCPA (2-Methyl-4-chlorophenoxyacetic acid) and Bromoxynil (3,5-Dibromo-4-hydroxybenzonitrile) in Fortified Wheat Grain and Straw: Report No. C-804. (Unpublished study received Nov 14, 1975 under 6F1703; prepared in cooperation with Biodynamics, Inc. and State Univ. of New York—Oswego, Lake Ontario Environmental Laboratory, submitted by American Cyanamid Co., Princeton, N.J.; CDL:094738-G)
000005570	Higham, J.W.; Feeny, R.W. (1974) Avenge^{R} (CL 84,777): Determination of Bromoxynil (3,5-Dibromo-4-hydroxylenzonitrile) and MCPA (2-Methyl-4-chlorophenoxyacetic acid) Residues in Wheat Grain Following Ground, Postemergence Application Where Each Was Applied in Combination with Avenge (1,2-Dimethyl-3,5-diphenyl pyrazolium methyl sulfate), (Oregon): Report No. C-578. (Unpublished study received Nov 14, 1975 under 6F1703; prepared in cooperation with State Univ. of New York--Oswego, Lake Ontario Environmental Laboratories, submitted by American Cyanamid Co., Princeton, N.J.; CDL:094738-Z)
000004650	Higham, J.W.; Feeny, R.W. (1974) Avenge^{R} (CL 84,777): Determination of MCPA (2-Methyl-4-chlorophenoxyacetic acid) Residues in Wheat Grain and Straw Following Ground, Postemergence Application in Combination with Avenge (1,2-Dimethyl 3,5-diphenyl pyrazolium methyl sulfate), (Montana): Report No. C-577. (Unpublished study received Nov 14, 1975 under 6F1703; prepared in cooperation with State Univ. of New York—Oswego, Lake Ontario Environmental Laboratories, submitted by American Cyanamid Co., Princeton, N.J.; CDL:094738-X)

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting Registrations Under the Standard

MRID #	CITATION
000005567	Higham, J.W.; Feeny, R.W.; Cheston, K.G.; Snyder, E.H.; Wingfield, C.B. (1975) Avenge^{R} (AC 84,777): Determination of CL 84,777 (1,2-Dimethyl-3,5-diphenyl pyrazolium methyl sulfate), Bromoxynil (3,5-Dibromo-4-hydroxylbenzonitrile) and MCPA (2-Methyl-4-chlorophenoxyacetic acid) Residues in Barley Grain and Straw Following Ground Application (Colorado): Report No. C-594. (Unpublished study received Jan 8, 1975 under 241-EX-64; prepared in cooperation with Lake Ontario Environmental Laboratory, submitted by American Cyanamid Co., Princeton, N.J.; CDL:224170-T)
000004611	Higham, J.W.; Feeny, R.W.; Snyder, E.H; Kushnak, G.; O'Hare, T.R. (1975) Avenge^{R} (CL 84,777): Determination of CL 84,777 (1,2-Dimethyl-3,5-diphenyl pyrazolium methyl sulfate), Bromoxynil (3,5-Dibromo-4-hydroxylbenzonitrile) and MCPA (2-Methyl-4-chlorophenoxyacetic acid) Residues in Barley Grain and Straw Following Ground Application of Avenge Alone and in Combination with MCPA, Bromoxynil, 2,4-D and Bromoxynil plus MCPA: Montana: Report No. C-593. (Unpublished study received Jan 8, 1975 under 241-EX-64; prepared in cooperation with Montana State Univ. and Lake Ontario Environmental Laboratory, submitted by American Cyanamid Co., Princeton, N.J.; CDL:224170-S)
000004613	Higham, J.W.; Feeny, R.W; Cheston, K.G.; Snyder, E.H.; Nowatski, R.; O'Hare, T.R. (1975) Avenge^{R} (CL 84,777): Determination of CL 84,777 (1,2-Dimethyl-3,5-diphenyl pyrazolium methyl sulfate), Bromoxynil (3,5-Dibromo-4-hydroxylbenzonitrile) and MCPA (2-Methyl-4-chlorophenoxyacetic acid) Residues in Barley Grain and Straw Following Ground Application of Avenge Alone and in Combination with MCPA, Bromoxynil or 2,4-D (North Dakota): Report No. C-596. (Unpublished study received Jan 8, 1975 under 241-EX-64; prepared in cooperation with Lake Ontario Environmental Laboratory, submitted by American Cyanamid Co., Princeton, N.J.; CDL:224170-V)
005014853	Holroyd, J. (1957) The breakdown of MCPA, 2,4-D and CIPC in soil. Pages 793-801, *In* Proceedings of the 3rd British Weed Control Conference; 1956, Blackpool, England. Vol. 2. Droitwich, England: British Weed Control Conference.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
000004756	Holsing, G.C. (1968) Final Report: 13-Week Dietary/Oral Administration--Dogs: Project No. 517-101. (Unpublished study received Jan 22, 1971 under 9F0761; prepared by Hazleton Laboratories, Inc., submitted by National Agricultural Chemicals Association, Industry Task Force on Phenoxy Herbicide Tolerances, Washington, D.C.; CDL:091309-A)
000004757	Holsing, G.C. (1970) Final Report: 13-Week Dietary Administration--Dogs: Project No. 517-107. (Unpublished study received Jan 22, 1971 under 9F0761; prepared by Hazleton Laboratories, Inc., submitted by National Agricultural Chemicals Association, Industry Task Force on Phenoxy Herbicide Tolerances, Washington, D.C.; CDL:091309-B)
000004775	Holsing, G.C.; Kundzin, M. (1968) Final Report: Three-Month Dietary Administration--Rats: Project No. 517-100. (Unpublished study received Dec 18, 1970 under 9F0761; prepared by Hazleton Laboratories, Inc., submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:094531-B)
000004776	Holsing, G.C.; Kundzin, M. (1970) Final Report: Three-Month Dietary Administration--Rats: Project No. 517-106. (Unpublished study received Dec 18, 1970 under 9F0761; prepared by Hazleton Laboratories, Inc., submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:094531-C)
005015747	Hopkins, R.; Kain, J.M. (1971) The effect of marine pollutants on Laminarea hyperboria. Marine Pollution Bulletin 2(5):75-77.
005020356	Hutber, G.N.; Rogers, L.J.; Smith, A.J. (1979) Influence of pesticides on the growth of cyanobacteria. Zeitschrift fur Allgemeine Mikrobiologie 19(6):397-402.
000004993	IR-4 Project at Rutgers, the State University (1974) MCPA--Sorghum Residue Studies. (Unpublished study received Oct 3, 1975 under 6E1681; CDL:097351-A)
000041637	Irvine, L.F.H.; Whittaker, D.; Hunter, J.; et al. (1980) M.C.P.A. Oral Teratogenicity Study in the Dutch Belted Rabbit: Report No. 1737R-277/5. (Unpublished study including submitter summary, received Aug 28, 1980 under 2217-EX-2; prepared by Hazleton Laboratories Europe, Ltd., submitted by PBI-Gordon Corp., Kansas City, Kans.; CDL:243170-A)

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
000004439	Jensen, D.J.; Miller, P.W.; Berhenke, L.F. (1973) Total Residues of MCPA and 2-Methyl-4-chlorophenol in Tissues of Animals Fed MCPA: Report No. GH-C-689. (Unpublished study received on unknown date under 9F0761; submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:092000-D)
005004434	Jensen, H.L.; Petersen, H.I. (1952) Decomposition of hormone herbicides by bacteria. Acta Agriculturae Scandinavica 2:215-231.
005003757	Jensen, H.L.; Petersen, H.I. (1952) Detoxication of hormone herbicides by soil bacteria. Nature (London) 170(4314):39-40.
005004656	Jensen, H.L.; Sorensen, H. (1952) The influence of some organic sulfur compounds and enzyme inhibitors on *Nitrosomonas europaea*. Acta Agricultural Scandinavica 2:295-304.
005008955	Jones, D.I.R.; Knight, A.G.; Smith, A.J. (1967) Attempted suicide with herbicide containing MCPA. Archives of Environmental Health 14(2):363-366.
005004190	Johnson, H.R.M.; Koumides, O. (1965) A further case of M.C.P.A. poisoning. British Medical Journal 2(5462):629-630.
005015461	Kaufman, P.B.; Crafts, A.S. (1956) Responses of the rice plant to different formulations and methods of application of 2,4-D, MCP, and 2,4,5-T. Hilgardia 24(15):411-453.
005005526	Kavanagh, B.V.; Posner, A.M.; Quirk, J.P. (1977) The adsorption of phenoxyacetic acid herbicides on goethite. Journal of Colloid and Interface Science 61(3):545-553.
000004576	Kemish Vaerk Koge A/S (1972) Determination of MCPA in MCPA-Isopropylester. Method dated Feb 18, 1972. (Unpublished study received Mar 6, 1972 under 9618-10; submitted by Trans Chemic Industries, Inc., New York, N.Y.; CDL:128581-A)
005005091	Kingham, H.G.; Fletcher, J.T. (1963) The effects of MCPA and 2,3,6-TBA on glasshouse cucumbers. Weed Research 3(3):242-245.
005015041	Kirkwood, R.C.; Dalziel, J.; Matlib, A.; Somerville, L. (1969) Some factors influencing the activity of foliage applied MCPA and MCPB in *Vicia faba* . Pages 650-658, *In Proceedings of the 9th British Weed Control Conference*; 1968. Vol. 2. Droitwich, England: British Weed Control Conference.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
005004272	Kirkwood, R.C.; Dalziel, J.; Matlib, A.; Somerville, L. (1972) The role of translocation in selectivity of herbicides with reference to MCPA and MCPB. Pesticide Science 3(3):307-321.
005019112	Kulinska, D. (1967) Wplyw herbicydow na pobieranie tlenu przez glebe. [Effect of herbicides on oxygen uptake by soil.] Roczniki Nauk Rolniczych, Seria A. [Annals of Agricultural Sciences, Series A.] 93(1):125-130.
005009678	Kunert, G. (1959) Der Einfluss einiger Herbicide auf die Lipaseaktivitaet von *Aspergillus niger* . [Effect of some herbicides on the lipase activity of *Aspergillus niger* .] Naturwissenschaften 46(21):603.
005021559	Lallukka, R. (1974) Rester av TCA, linuron, dicamba och MCPA i skordeprodukter efter odling i behandlad jord--resultat fran finska undersokningar. [Residues of TCA, linuron, dicamba and MCPA in crops grown in treated soil--results of Finnish research.] Pages 114-115, *In* Herbicider i Jord--Verkan pa Kulturvaxter. [Herbicides in the Soil--Effects on Crop Plants.] Uppsala, Sweden: Agricultural College of Sweden, Department of Plant Husbandry.
005004440	Large, E.C.; Dillon Weston, W.A.R. (1951) Ear distortion in barley and other cereals caused by spraying with MCPA and 2,4-D. Journal of Agricultural Science 41(4):338-349.
005005848	Lavake, D.E.; Chenault, E.W.; Wiese, A.F.; Vandiver, C.W. (1971) Tolerance of sorghum hybrids to postemergence herbicides. Pages 74-105, *In* Texas Agricultural Experiment Station Progress Report. College Station, Tex.: Texas Agricultural Experiment Station.
005005795	Leafe, E.L. (1962) Metabolism and selectivity of plant-growth regulator herbicides. Nature 193(4814):485-486.
005006390	Lee, S.A. (1972) Effects of six post-emergence herbicides on young pineapple. Malaysian Pineapple 2:47-52.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
000004765	Leng, M.L., comp. (1970) Summary of Residue Data for MCPA on Rice and Rice Byproducts. (Unpublished study received Jan 22, 1971 under 9F0761; prepared by Dow Chemical Co. in cooperation with Univ. of California--Davis, Dept. of Environmental Toxicology, Agricultural Toxicology Laboratory, submitted by National Agricultural Chemicals Association, Industry Task Force on Phenoxy Herbicide Tolerances, Washington, D.C.; CDL:091308-M)
000004622	Leng, M.L., comp. (1971) Summary of Residue Data for 2,4-D; 2,4,5-T; Silvex and MCPA in Milk, Meat and Meat Byproducts. (Unpublished study received Oct 11, 1971 under 9F0761; prepared by Dow Chemical Co., submitted by National Agricultural Chemicals Association, Industry Task Force on Phenoxy Herbicide Tolerances, Washington, D.C.; CDL:091311-C)
005016100	Loos, M.A. (1971) Metabolism of phenoxy herbicides by plants and soil micro-organisms. Pages 291-304, *In* Pesticide Terminal Residues: Invited Papers from the International Symposium on Pesticide Terminal Residues; Feb 17-19, 1971, Tel Aviv, Israel. Edited by A.S. Tahori. London: Butterworths.
005003910	Loos, M.A.; Bollag, J.M.; Alexander, M. (1967) Phenoxyacetate herbicide detoxication by bacterial enzymes. Journal of Agricultural and Food Chemistry 15(5):858-860.
005012194	Loos, M.A.; Schlosser, I.F.; Mapham, W.R. (1979) Phenoxy herbicide degradation in soils: quantitative studies of 2,4-D- and MCPA-degrading microbial populations. Soil Biology and Biochemistry 11(4):377-385.
005016319	Luckwill, L.C.; Campbell, A.I. (1957) The tolerance of fruit crops to certain selective and pre-emergence herbicides. Pages 539-542, *In* Proceedings of the 3rd British Weed Control Conference; 1956, Blackpool, England. Droitwich, England: British Weed Control Conference.
005016939	Magnusson, J.; Ramel, C.; Eriksson, A. (1977) Mutagenic effects of chlorinated phenoxyacetic acids in *Drosophila melanogaster*. Hereditas 87:121-123.
005003450	Malina, M. (1971) Collaborative study of infrared analysis of dicamba-2-methyl-4-chlorophenoxyacetic acid and dicamba-2,4-dichlorophenoxyacetic acid formulations. Journal of the Association of Official Analytical Chemists 54(3):706-710.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting Registrations Under the Standard

MRID #	CITATION
GS 0017-110	Marquardt and Luce (1955) Jour. Agr. Food Chem. 3:51
005004185	Matell, M.; Lindenfors, S. (1957) Thermodynamic dissociation constants of 2,4-dichlorophenoxyacetic acid (2,4-D) and some related plant growth regulators. Acta Chemica Scandinavica 11(2):324-328.
005015451	Matlib, M.A.; Kirkwood, R.C.; Patterson, J.D.E. (1971) Binding of certain substituted phenoxy-acids by bovine serum albumin. Weed Research 11(2/3):190-192.
000026928	McCann, J.A.; Pitcher, F. (1972) [MCP Weed Killer: Toxicity to Bluegill]: Test No. 512. (U.S. Agricultural Research Service, Pesticides Regulation Div., Animal Biology Laboratory, unpublished report.)
005019847	Metting, B.; Rayburn, W. (1979) The effects of the pre-emergence herbicide di-allate and the post-emergence herbicide MCPA on the growth of some soil algae. Phycologia 18(3):269-272.
05013388	Meadly, G.R.W.; Pearce, G.A. (1957) The tolerance of subterranean clover (Trifolium subterraneum L) to chlorinated phenboxyacetic derivatives. Journal of the Department of Agricultural, Western Australia 6:357-361, 364-368, 371-374, 377-380.
005013713	Miller, J.H.; Kempen, H.M.; Wilkerson, J.A.; Foy, C.L. (1963) Response of Cotton to 2,4-D and Related Phenoxy Herbicides. Washington, D.C.: U.S. Department of Agriculture, Agricultural Research Service. (USDA technical bulletin no. 1289)
000004438	Miller, P.W.; Jensen, D.J. (1973) Study of Alkaline Hydrolysis for Determination of Residues of MCPA and 2-Methyl-4-chlorophenol in Milk: Report No. GH-C 628. Method dated Feb 13, 1973. (Unpublished study received on unknown date under 9F0761; submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:092000-C)
000003472	Mobil Chemical Company (1973) Experiment: Wheat Herbicide Screening. (Unpublished study received May 7, 1974 under 4G1505; CDL:093987-AR)

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting Registrations Under the Standard

MRID #	CITATION
000004773	Monsanto Company (1956) [MCP Residue in and Recovery of MCP from Garden Peas, Flax, Rice and Oats]. (Unpublished study received Oct 19, 1971 under 8F0676; submitted by National Agricultural Chemicals Association, Industry Task Force on Phenoxy Herbicide Tolerances, Washinton, D.C.; CDL:091183-O)
000004441	Monsanto Company (19??) Petition for the establishment of tolerances for the pesticide chemical 2-methyl-4-chlororophenoxyacetic acid (MCPA) on raw agricultural commodities, Section D: The results of tests on the amount of residues remaining, including a description of the analytical method used. (Submitted by the National Agricultural Chemicals Association Industry Task Force on Phenoxy Herbicide Tolerances. December 12, 1967).
00005552	Monsanto Company (1956) Procedures for determining residues of MCP (2-methyl-4-chlorophenoxyacetic acid/in treated crops.
000005575	Montgomery, M.L. (1970) MCPA Residue in Wheat: Oregon State University Report. Includes methods dated Jun 17, 1970 and Apr 1, 1970. (Unpublished study including summary report and letters dated Apr 2, 1970 from M.L. Montgomery to Don T. Lillie and J.A. Ignatoski, received Jan 22, 1971 under 9F0761; prepared by Oregon State Univ., Dept. of Agricultural Chemistry, submitted by National Agricultural Chemicals Association, Industry Task Force on Phenoxy Herbicide Tolerances, Washington, D.C.; CDL:091308-I)
005004849	Moore, R.M. (1950) Differential effects of certain phenoxyacetic acid compounds and phenylcarbamates on plant species: II. Effects of foliage applications with special reference to yields of wheat. Australian Journal of Agricultural Research 44:401-412.
005021735	Mueller, F. (1976) Summary. Pages 141-144, In Translokation von 14C-markiertem MCPA in verschiedenen Entwicklungsstadien mehrjaehriger Unkraeuter. [Translocation of 14C-Labelled MCPA at Different Stages of Development of Perennial Weeds.] Berlin, Germany: Verlag Paul Parey. (Acta phytomedica, vol. 4)

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting Registrations Under the Standard

MRID #	CITATION
005005548	Nakajima, S.; Naito, N.; Tani, T. (1973) Microbial transformation of 2,4-D and its analogues. Chemical and Pharmaceutical Bulletin 21(3):671-673.
005002356	Nelson, N.H.; Faust, S.D. (1969) Acidic dissociation constants of selected aquatic herbicides. Environmental Science and Technology 3(11):1186-1188.
005020766	Noll, M.; Bauer, U. (1974) Phormidium autumnale als Indikatororganismus fuer algizide Substanzen im wasser.
000004447	Palmer, A.K.; Lovell, M.R. (19??) Effect of MCPA on Pregnancy of the Mouse. (Unpublished study received on unknown date under 9F0761; prepared by Huntingdon Research Centre, England, submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:092001-C)
005015694	Parascan, D. (1966) Cercetari privind actiunea ierbicidelor asupra semintelor de molid in timpul germinatiei lor. [Herbicide action on the spruce seed during germination.] Revista Padurilor. [Forestry Review.] 81(10):543-547.
000004805	Parke, G.St.E.; Terrell, Y. (1974) Report: Eight Day Dietary LC50 Study of Amchem Weedar Sodium MCPA in Bobwhite Quail and Mallard Ducks. (Unpublished study received Jul 15, 1975 under 264-55; prepared by Cannon Laboratories, Inc. for Amchem Products, Inc., submitted by Union Carbide Agricultural Products Co., Ambler, Pa.; CDL:132039-A)
000021979	Paudler, W.W. (1979) Analyses of N-Nitroso Compounds. (Unpublished study received Jul 23, 1979 under 39335-1; prepared by Univ. of Alabama, Dept. of Chemistry, Mass Spectroscopy Laboratory, submitted by Fallek-Lankro Corp., Tuscaloosa, Ala.; CDL:238873-A)
000026927	Pitcher, F.G. (1973) [Spot Treat: Toxicity to Bluegill]: Test No. 609. (U.S. Environmental Protection Agency, Pesticides Regulation Div., Agricultural Research Center, Animal Biology Laboratory, unpublished report.)

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting Registrations Under the Standard

MRID #	CITATION
005003770	Popham, R.D.; Davies, D.M. (1964) A case of M.C.P.A. poisoning. British Medical Journal 1(5384):677-678.
005009237	Propping, P.; Buselmaier, W.; Roehrborn, G. (1973) Kritische Betrachtung ueber die intra-animale Kultur von Mikroorganismen, eine Methode zum Nachweis chemisch induzierter Mutationen.
00021973	Raltech Scientific Services, Inc. (19??) MCPA dermal LD_{50} study in New Zealand white strain rabbits.
00021976	Raltech Scientific Services, Inc. (19??) MCPA primary dermal irritation study in New Zealand white strain rabbits.
00021974	Raltech Scientific Services, Inc. (19??) MCPA primary dermal eye irritation study in New Zealand white strain rabbits.
00021972	Raltech Scientific Services, Inc. (19??) MCPA Oral defined LD_{50} study in Sprague-Dawley albino rats.
005013116	Reynolds, J.D.; Proctor, J.M.; Hind, R.A. (1957) Studies with phenoxybutyric herbicides in peas, 1955-56. Pages 499-513, In Proceedings of the 3rd British Weed Control Conference; 1956, Blackpool, England. Droitwich, England: British Weed Control Conference.
005004197	Rhodes, A.; Templeman, W.G. (1947) Effect of 4-chloro-2-methyl phenoxyacetic acid on the mineral content and growth of plants letter. Nature 160(4076):825-826.
000004594	Rhodia, Incorporated (1971) Phenoxy Herbicides on Stubble Crop Rice. (Unpublished study received Nov 21, 1973 under 359-170; submitted by Rhone-Poulenc, Inc., Monmouth Junction, N.J.; CDL: 230485-B)
005015046	Robertson, M.M.; Kirkwood, R.C. (1967) Differential uptake and movement as a factor influencing selective toxicity of MCPA and MCPB. Pages 269-277, In Proceedings of the 8th British Weed Control Conference; 1966. Vol. 1. Droitwich, England: British Weed Control Conference.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
005006391	Rojas-Garciduenas, M.; Ruiz, M.A.; Carrillo, J. (1962) Effects of 2,4-D and MCPA on germination and early growth. Weeds 10(1):69-71.
005017929	Rolencova, H. (1978) Stanoveni nekterych pesticidnich latek v biologickem materialu. [Determination of some pesticides in biological material.] Veterinarstvi. [Veterinary Medicine.] 28(4):177-179.
000023687	Rydrych, D.; Behrens, R.; Wallace, K.; et al. (1972) [Residues from Various Chemicals on Grains]. (Unpublished study received Jan 3, 1973 under unknown admin. no.; prepared in cooperation with Univ. of Minnesota and others, submitted by Velsicol Chemical Corp., Chicago, Ill.; CDL:120182-A)
005015695	Sanad, A.J. (1971) Untersuchungen ueber Aufnahme und Translokation von 14C-markierten Herbiziden in Agrostemma githago L. und Tussilago farfara L. [Studies of the uptake and translocation of 14C-labelled herbicides in Agrostemma
005005247	Sattar, M.A.; Paasivirta, J. (1979) Effects of MCPA on the germination and root system of cereal crops. Chemosphere 8(4):201-203.
005003508	Seiler, J.P. (1979) Phenoxyacids as inhibitors of testicular DNA synthesis in male mice. Bulletin of Environmental Contamination and Toxicology 21(1/2):89-92.
005013749	Sen, K.M. (1960) Studies on the Influence of Some Auxin Herbicides on Grass-seed Crops. Wageningen, Netherlands: Centrum voor Landbouwpublikaties en Landbouwdocumentatie. (Verslagen van Landbouwkundige Onderzoekingen no. 66.11)
000022698	Sleight, B.H., III (1973) Acute Toxicity of Mondak to Bluegill (Lepomis.macrochirus) and Rainbow Trout (Salmo.gaird neri) Report No. 040280. (Unpublished study received May 21, 1973 under unknown admin. no.; prepared by Bionomics, Inc., submitted by Velsicol Chemical Corp., Chicago, Ill.; CD:128293-A)

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
000004448	Soderquist, C.J.; Crosby, D.G. (1974) The Dissipation of 4-Chloro-2-methylphenoxyacetic acid (MCPA) in a Rice Field. Includes four methods dated Apr 15, 1974. (Unpublished study received on unknown date under 9F0761; prepared by Univ. of California--Davis, Dept. of Environmental Toxicology, submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:092001-E)
005003445	Soderquist, C.J.; Crosby, D.G. (1975) Dissipation of 4-chloro-2-methylphenoxyacetic acid (MCPA) in a rice field. Pesticide Science 6(1):17-33.
005012269	Sokolov, M.S.; Knyr, L.L.; Strekozov, B.P.; Agarkov, V.D. (1975) Osobennosti povedeniya propanida, yalana, 2M-4Kh i 2,4-D v risovykh orositel'nykh sistemakh Kubani. [Behavior of propanide, yalan, MCPA and 2,4-D in rice irrigation systems of the Kuban River.] Khimiya v Sel'skom Khozyaistve. [Chemistry in Agriculture.] 13(3):224-234.
005010497	Sokolov, M.S.; Knyr, L.L.; Strekozov, B.P.; Agarkov, V.D.; Chubenko, A.P.; Kryzhko, B.A. (1974) Povedenie nekotorykh gerbitsidov v usloviyakh risovoi orositel'noi sistemy. [The behavior of some herbicides under the conditions of a rice irrigation system.] Agrokhimiya. [Agricultural Chemistry.] (3):95-106.
005020404	Sommer, K. (1970) Beeinflussung der Nitrifikation und des Stickstoffhaushaltes in Boeden durch verschiedene Pflanzenschutzmittel. [Effect of various pesticides on nitrification and nitrogen transformations in soils.] Landwirtschaftliche Forschung, Sonderheft 25:22-30.
000021962	Song, L. (1977) Formal Report of Analysis: Contract No. 000563. Undated method. (Unpublished study received Jul 12, 1978 under 39335-7; prepared by Thermo Electron Corp., submitted by Fallek-Lankro Corp., Tuscaloosa, Ala.; CDL:236544-A)
000004995	St. John, L.E., Jr. (1965?) MCPA. Pages 439-454, In By N.P (Also In unpublished submission received Jan 18, 1975 under 241-EX-64; submitted by American Cyanamid Co., Princeton, N.J.; CDL:224170-Z)

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
000004724	St. John, L.E., Jr. (1967) MCPA. Pages 445-454, *In* Analytical Methods for Pesticides, Growth Regulators and Food Additives: Volume 5. Edited by G. Zweig. New York: Academic Press. (Also *In* unpublished submission received Sep 12, 1968 under 8F0676; submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:092980-A)
005019284	State Institute of Agricultural Chemistry, Finaldn (1977) Residue Analysis of the Official Testing of Pesticides, 1976. Helsinki, Finland: State Institute of Agricultural Chemistry. (State Institute of Agricultural Chemistry publication No. 12)
005015452	Steenson, T.I.; Walker, N. (1956) Observations on the bacterial oxidation of chlorophenoxyacetic acids. Plant and Soil VIII(1):17-32.
005004430	Steenson, T.I.; Walker, N. (1957) The pathway of breakdown of 2:4-dichloro- and 4-chloro-2-methyl-phenoxyacetic acid by bacteria. Journal of General Microbiology 16(1):146-155.
005013551	Steenson, T.I.; Walker, N. (1958) Adaptive patterns in the bacterial oxidation of 2:4-dichloro- and 4-chloro-2-methyl-phenoxyacetic acid. Journal of General Microbiology 18(3):692-697.
005012650	Stevens, T.; Grorud, R.B. (1979) High pressure liquid chromatography of ester and salt formulations of 2-methyl-4-chlorophenoxyacetic acid. Journal of the Association of Official Analytical Chemists 62(4):738-741.
005001991	Stevenson, J.H. (1978) The acute toxicity of unformulated pesticides to worker honey bees (*Apis mellifera* L.). Plant Pathology 27(1):38-40.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
000004568	Suzuki, H.K. (1977) Dissipation of Banvel, Bromoxynil or MCPA or Combination Thereof in Two Soil Types: Report No. 181. (Unpublished study received Nov 2, 1977 under 876-25; prepared in cooperation with International Research and Development Corp.; submitted by Velsicol Chemical Corp., Chicago, Ill.; CDL: 232171-B)
005009727	Synek, M.; Tibenska, M.; Veresikova, M. (1973) Znehodnotenie podzemnych vod dikotexom (Na-sol'ou kyseliny 2-methyl-4-chlorfenoxyoctovej). [Contamination of ground waters with dikotex (Na-salt 2-methyl-4-chlorophenoxyacetic acid.] Bratislavske Lekarske Listy. [Bratislava Medical News.] 59(2):203-207.
005003614	Synerholm, M.E.; Zimmerman, P.W. (1945) The preparation of some substituted phenoxy alkyl carboxylic acids and their properties as growth substances. Contributions from Boyce Thompson Institute 14:91-103.
005020337	Talbot, F.; Foster, R.T., inventors; Imperial Chemical Industries, assignee (1952) Improvements in or relating to the production of soluble salts of methylchlorophenoxyacetic acids. British patent specification 664,069. Jan 2. 7 p.
005020338	Talbot, F., inventor; Imperial Chemical Industries, assignee (1949) Improvements in or relating to 2-methyl-4-chloro-phenoxyacetic acid. British patent specification 623,217. May 13. 4 p.
000004443	Thornburg, W. (1973) MCPA Residues in Peas: A Summary of Residue Data. (Unpublished study received on unknown date under 9F0761; prepared by Del Monte Corp., submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:092000-I)
005003431	Tin, U.; Baruah, P.; Baruah, H.K. (1949) Biological effects of methoxone on water hyacinth. Science and Culture 15(3):106-109.
005020144	Tooby, T.E.; Hursey, P.A.; Alabaster, J.S. (1975) The acute toxicity of 102 pesticides and miscellaneous substances to fish. Chemistry and Industry (London) (12):523-526.
005004188	Torstensson, L. (1974) Effects of MCPA, 2,4,5-T, linuron and simazine on some functional groups of soil microorganisms. Swedish Journal of Agricultural Research 4(3):151-160.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
005004429	Torstensson, L. (1975) Effects of bentazon and dinoseb on soil microorganisms and on the Rhizobium-Leguminosae symbiosis. Swedish Journal of Agricultural Research 5(4):177-183.
005008552	Torstensson, N.T.L. (1975) Degradation of 2,4-D and MCPA in soils of low pH. Pages 262-265, In Pesticides: IUPAC Third International Congress; Jul 3-9, 1974, Helsinki, Finland. Edited by F. Coulston and F. Korte. Stuttgart, West Germany: George Thieme. (Environmental Quality and Safety, Supplement, vol. 3)
005004649	Torstensson, N.T.L.; Stark, J.; Goransson, B. (1975) The effect of repeated applications of 2,4-D and MCPA on their breakdown in soil. Weed Research 15(3):159-164.
005004846	Tottman, D.R.; Davies, E.L.P. (1978) The effect of herbicides on the root system of wheat plants. Annals of Applied Biology 90(1):93-99.
005016148	Toure, I.M.; Stenz, E. (1977) Der Einfluss ausgewaehlter Herbizide auf Bakteriophagen und Escherichia coli . [The action of selected herbicides on bacteriophages and Escherichia coli .] Zentralblatt fuer Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygieine, Abteilung II 132:163-177.
000041635	Tucker, M.L.; Irvine, L.F.H. (1978) MCPA Oral Teratogenicity Dose Ranging Study in Rabbits: Report No. 684R-277/4. (Unpublished study including submitter summary, received Sep 4, 1980 under 2217-EX-2; prepared by Hazleton Laboratories Europe, Ltd., submitted by PBI-Gordon Corp., Kansas City, Kans.; CDL:243196-A)
000022673	Union Carbine Corporation (1975?) Acute Toxicity of Mondak 5P48 to Grass Shrimp, Palaemonetes Vulgaris and Fiddler Crabs, Una Pugilator. (Unpublished study received Feb 28, 1979 under 876-45; submitted by Velsicol Chemical Corp., Chicago, Ill.; CDL:237738-A)
000022504	Union Carbide Corporation (1976) Acute Toxicity of Mondak 5P48 to the Water Flea Daphnia magna Straus. (Unpublished study received Aug 31, 1976 under 876-45; submitted by Velsicol Chemical Corp., Chicago, Ill.; CDL:225589-A)

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
GS 0017-104	U.S. EPA 1972. Report on the toxicity of MCPA dimethylamine salt 52.2% a.i. (Midlnd MCP Weed Killer) to bluegill and rainbow trout. (U.S. EPA, Chemical and Biological Investigation Branch, Beltsville, Md.; Static Jar Test Nos. 512, 11/72; 525, 12/72; unpublished report).
GS 0017-105	U.S. EPA 9173. Report on the toxicity of MCPA, sodium salt 24% a.i. (Spot Treat) to bluegill. (U.S. EPA, Chemical and Biological Investigation Branch, Beltsville, Md.; Static Jar Test No. 628, 9/73; unpublished report).
GS 0017-106	U.S. EPA 1973. Report on the toxicity of MCPA, sodium salt 24%, a.i. (Weedar sodium MCPA) to bluegills (U.S. EPA, Chemical and Biological Investigation Branch Beltsville, Md.; Static Jar Test No. 693, 10/73; unpublished report.
GS 0017-107	U.S. EPA 1973. Report on the toxicity of MCPA, dimethylamine salt 52.1% a.i. (Dow MCP Amine Weed) to rainbow trout and bluegills (U.S. EPA, Chemical and Biologist Investigation Branch, Beltsville, Md.; Static Jar Test Nos. 553; 3/73 and 580, 5/73; unpublished report).
GS 0017-108	U.S. EPA 1976. Report on the Toxicity of MCPA 94% active ingredient (technical grade) to rainbow trout, *Daphnia magna* and bluegill. (U.S. EPA, Chemical and Biological Investigation Branch, Beltsville, Md.; Static Jar Test No. 927, 1/19/76; Test No. 936, 2/2/76; Test No. 942, 2/9/76; and Test No. 972, 4/21/76; unpublished report).
000004549	Velsicol Chemical Corporation (1965) Flax. (Unpublished study received Jan 28, 1966 under 876-25; prepared in cooperation with North Dakota State Univ. of Agriculture and Applied Science, Dept. of Agronomy and Univ. of Minnesota; CDL:022209-A)
000005569	Velsicol Chemical Corporation (1972) Summary: [Tank Mixtures of Dicamba + Bromoxynil and Dicamba + Bromoxynil + MCPA for Weed Control]. (Unpublished study received Jan 3, 1973 under 876-25; CDL:005050-A)
000004566	Velsicol Chemical Corporation (1972) Wheat (Fall Seeded): Report No. 123. (Unpublished study received May 21, 1973 under 876-45; prepared in cooperation with Northwestern Agricultural Research Center; CDL:021027-A)

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID # CITATION

000004541 Velsicol Chemical Corporation (1974) Summary of Mondak Residue Studies--Winter Wheat. (Unpublished study including Velsicol Report #147 and #150, received Dec 11, 1974 under 876-45; CDL: 003548-A)

005019175 Verona, O. (1948) Effetti di alcuni erbicidi selettivi sulla microflora, in particolare, del terreno. [Effect of some selective herbicides on microflora, particularly of the soil.] Annali della Facolta di Agraria, Universita di Pisa. [Annals of the Faculty of Agriculture of the University of Pisa.] 9:189-199.

005008548 Vintikova, H.; Skrdleta, V.; Srogl, M. (1965) The sensitivity of nodule bacteria to several herbicides. Pages 264-268, In Plant Microbes Relationships: Proceedings of a Symposium on Relationships Between Soil Microorganisms and Plant Roots; Sep 24-28, 1963, Prague. Edited by J. Macura and V. Vancura. Prague, Czechoslovakia: Academia.

005003752 Vogel, E.; Chandler, J.L.R. (1974) Mutagenicity testing of cyclamate and some pesticides in Drosophila melanogaster. Experientia 30(6):621-623.

005004390 Vyas, L.N.; Garg, R.K. (1974) Reversal of the effect of growth inhibitors by gibberellic acid and indole acetic acid. Biochemie and Physiologie der Pflanzen 166(5/6):549-554.

005015458 Way, J.M. (1962) The effects of sub-lethal doses of MCPA on the morphology and yield of vegetable crops: I. Lettuce. Weed Research 2(4):233-246.

005015457 Way, J.M. (1963) The effects of sub-lethal doses of MCPA on the morphology and yield of vegetable crops: II. Cabbage, cauliflower and Brussels sprouts. Weed Research 3(1):11-25.

005015459 Way, J.M. (1963) The effects of sub-lethal doses of MCPA on the morphology and yield of vegetable crops: III. Carrots and parsnips. Weed Research 3(2):98-108.

005015456 Way, J.M. (1963) The effects of sub-lethal doses of MCPA on the morphology and yield of vegetable crops: IV. French and broad beans. Weed Research 3(4):312-321.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
005019963	Way, J.M. (1964) The effects of sub-lethal doses of MCPA on the morphology and yield of vegetable crops: V. Beet, spinach, turnip and onion. Weed Research 4(1):12-23.
005015754	Way, J.M. (1964) The effects of sub-lethal doses of MCPA on the morphology and yield of vegetable crops: VI. Comparison with 2,4-D, 2,4,5-T, mecoprop and 2,3,6-TBA. Weed Research 4(4):319-337.
005015407	Wehr, N.B.; Klein, D.A. (1971) Herbicide effects on *Bdellovibrio bacteriovorus* parasitism of a soil pseudomonad. *Soil Biology and Biochemistry* 3(2):143-149.
000004589	Welch, J. (1974) Final Report: District Project No. 244274-004. (Unpublished study received Mar 24, 1976 under 359-170; prepared by Rhodia, Inc., submitted by Rhone-Poulenc, Inc., Monmouth Junction, N.J.; CDL:223772-N)
000005558	Welch, J. (1974) Product Development Department: Final Report: District Project No. 244274-003. (Unpublished study received Mar 24, 1976 under 359-170; prepared by Rhodia, Inc., submitted by Rhone-Poulenc, Inc., Monmouth Junction, N.J.; CDL:223772-L)
005006301	Wiedman, S.J.; Appleby, A.P. (1972) Plant growth stimulation by sublethal concentrations of herbicides. Weed Research 12(1):65-74.
005006526	Wilkinson, V.; Lucas, R.L. (1969) Effects of herbicides on the growth of soil fungi. New Phytology 68(3):709-719.
000004453	Winterlin, M.; Radosivich, S.R. (1974) Report of Analysis: Environmental Toxicology Report No. 3445. Includes undated method. (Unpublished study received Feb 10, 1976 under 6E1746; prepared by Univ. of California—Davis, Dept. of Environmental Toxicology, submitted by Interregional Research Project No. 4, New Brunswick, N.J.; CDL:095368-C)
000005577	Wirth, M.; Wasco, J.L. (19??) MCP-/amine Weed Killer: Evaluation of Formulation M-3539. Includes undated method. (Unpublished study received Jul 17, 1970 under 464-147; submitted by Dow Chemical U.S.A., Midland, Mich.; CDL:003427-A)
005003566	Yasuda, M.; Maeda, H. (1972) Teratogenic effects of 4-chloro-2-methylphenoxyacetic acid ethylester (MCPEE) in rats. Toxicology and Applied Pharmacology 23(2):326-333.

OFFICE OF PESTICIDE PROGRAMS
REGISTRATION STANDARD BIBLIOGRAPHY
Citations Considered to be Part of the Data Base Supporting
Registrations Under the Standard

MRID #	CITATION
GS 0017-109	Yip and Ney (1966) Analysis of 2,4-D residues in milk and forage. Weeds 14:167.
005021608	Zauner, E.; Bronn, W.K.; Dellweg, H.; Tressl, R. (1979) Hemmwirkung von Nebenkomponenten der Ruebenmelasse und von Pflanzenschutzmitteln auf die Atmung und Gaerung von Hefe (*Saccharomyces cerevisiae*). [Inhibitor activity of impurities of beet molasses and plant protectants on the respiration and fermentation of yeast (*Saccharomyces*)
005004970	Zetterberg, G. (1979) Mechanism of the lethal and mutagenic effects of phenoxyacetic acids in *Saccharomyces cerevisiae* . Mutation Research 60(3):291-300.
005005846	Zweig, G.; Sherma, J. (1972) 2,4-Dichlorophenoxyacetic acid. Pages 630-635, *In* Analytical Methods for Pesticides and Plant Growth Regulators. Vol. VI: Gas Chromatographic Analysis. New York: Academic Press.